Refurbishing a 'Jewel in the (Canadian) Crown': An Eddystone S830/4 – Gerry O'Hara

I have had the privilege of owning or refurbishing (or both!) several Eddystone S830 receivers over the years. The sets I have owned were all the S830/4 variant (see articles here, here, here, and here) – these were made for the Canadian government, so are the most commonly available here in Canada, and (annoyingly) lacked coverage of the main segment of the Broadcast band. This variant had an additional LF band instead, allowing continuous LF/MF coverage from 120 – 560KHz, with HF coverage from 1.5 – 30MHz. However, I have also had the opportunity to work on and operate two other S830 variants, the S830/2 (see article here), and the S830/7.

Background

I understand that the owner of this S830/4, who had decided to re-start his radio hobby again, was pointed in my direction to refurbish his recently acquired receiver after contacting the SPARC radio museum in Coquitlam, BC, Canada. He subsequently contacted me and then shipped the radio to my location (over 700Km distant by road, but also in BC[1]) in a very stout plywood crate padded with several thick stiff foam bats. I was busy with other projects at that time, so the unit sat in my 'waiting room' for a few weeks before I could start work on it.

The Eddystone S830

The very successful S830 receiver range included 13 variants in total, most listed in the Eddystone User Group's UQRG[2], page 38[3], and the model was manufactured over an eleven year period from 1962 – 1973. The UQRG indicates that 200 units of the original S830 were produced in 1962, with 415 units of the S830/4 produced between 1965 and 1967[4]. The UQRG notes that the S830/10 variant is also a 'Canadian Model', but does not identify how many were produced or how it differed from the S830/4.

The S830/4 Variant

The S830/4 is a 15 tube general coverage, dual-conversion receiver covering 120KHz – 30MHz in nine (slightly) overlapping ranges, with a gap between 560KHz and 1.5MHz, and was intended for the professional market. It is mains powered, but with facility to be powered by an external source(s), requiring 250vDC, at 160mA and 6.3v, AC or DC, at 4.8A. Provision was also made to power accessories from the internal power supply (250vDC at 15mA and 6.3vAC at 1.2A).

The set is dual-conversion on Bands 1 through 6, covering 1.5MHz - 30MHz, with a (tunable) 1st IF of 1350KHz (centre frequency), and 2nd IF of nominal 100KHz. Bands 7 through 9, covering 120 - 560KHz,

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[1] British Columbia, Canada (the author lives in Victoria, BC)

[2] 'Ultimate Quick Reference Guide' (2nd Ed.) on Eddystone receivers and related products, authored by Graeme Wormald (G3GGL, SK) for the Eddystone User Group (EUG) in 2005

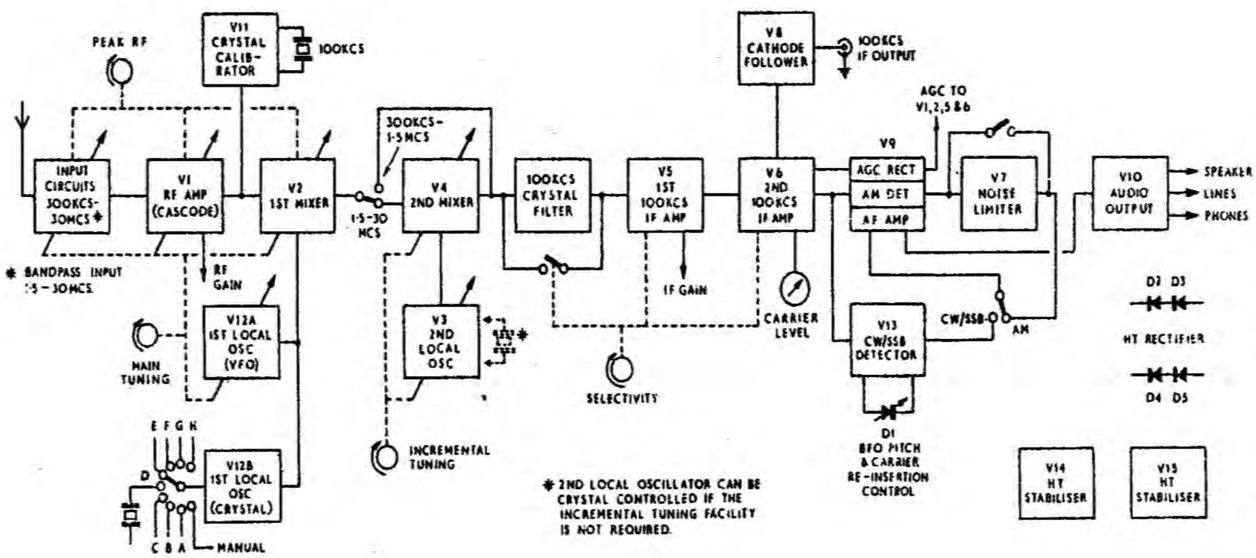
[3] The list of variants in the UQRG does not include the S830/1 or S830/3. The S830/1 variant is mentioned in Appendix 'A' to the S830/1,2,3 manual, noting *"… differs only in the type of knobs used for 'SELECTIVITY CONTROL', the 'SIGNAL MODE SWITCH', and the 'AGC/NL SWITCH'. Small 'beak' knobs are fitted in place of the standard chromium plated levers."*, as is the S830/3 variant, here noting "*…the only difference being the type of knob used for the RF gain control.*"

[4] These production dates contradict the Serial No. (GO0844, indicating July, 1963), however the serial numbers are known to be error prone

are single conversion, with an IF of nominal 100KHz. The 2nd local oscillator and 1st IF are tunable +/- 100KHz either side of the nominal 1st IF frequency to provide an 'Incremental Tuning' facility on these bands, giving a 1KHz or better frequency resolution when used in conjunction with the crystal calibrator. The 2nd local oscillator can be crystal controlled for maximum stability if desired. The 1st local oscillator can also be crystal controlled, with facility to switch up to eight crystals in place of the VFO.

Circuit Description

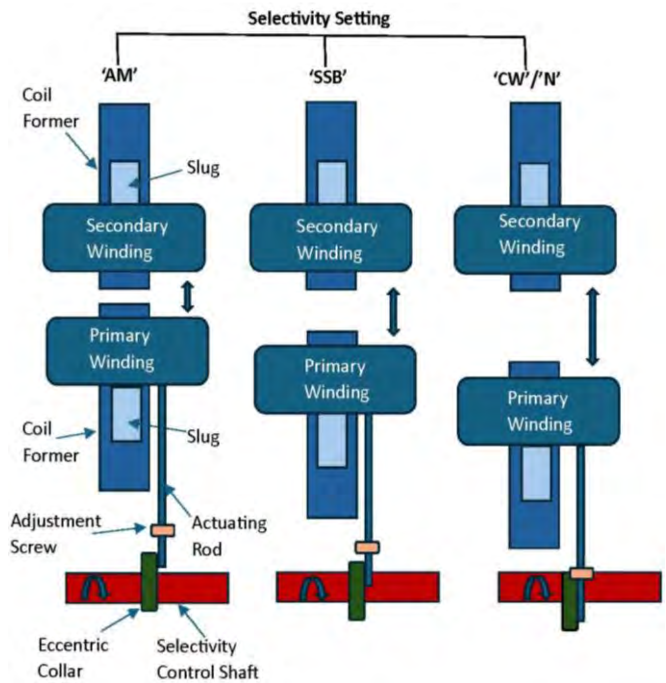
The block diagram of the S830/4 is shown below, and this should be referred to while reading the following overview of the S830/4 circuit. The full schematic is provided in the Appendix, and a more comprehensive circuit description can be found in the S830/4 manual, available from the [EUG website](#).



The antenna circuits are double-tuned on Bands 1 through 6, and single tuned on Bands 7 through 9. The RF amplifier is a double triode tube (ECC189) in cascode configuration, which couples the signal to the 1st mixer stage (6AK5) via single-tuned transformers on all bands. The variable frequency 1st local oscillator (VFO) is the pentode section of a 6U8 tube, and when crystal control is desired, the triode section of this tube takes over to provide the 1st local oscillator signal to the 1st mixer stage. A crystal bank with 8 x HC6/U style crystal sockets is installed, the crystal of choice ('A' through "H') being selected by a metal lever located behind, and concentric with, the band selector switch knob. The ninth position on this lever, 'M', at the fully CCW position, selects 'manual' (VFO) control of the 1st local oscillator.

In single-conversion mode (Bands 7 through 9), the plate of the 1st mixer tube is connected to the B+ supply through the primary winding of the 1st 100KHz (2nd IF) IF transformer. This transformer is double-tuned, with its secondary connected to the 100KHz crystal filter and (pre-set) crystal phasing capacitor. The crystal is shorted out in all selectivity settings except 'N'. The output of the 1st 100KHz IF transformer is loosely capacitively-coupled to the 2nd 100KHz IF 'transformer', which is actually a single parallel-tuned coil, the 'hot' end of which is capacitance-coupled to the grid of the 1st 100KHz IF amplifier tube (6BA6). The plate of this tube is connected to the B+ supply through the primary of the 3rd (double-tuned) 100KHz IF transformer, the secondary of which is capacitively-coupled to the grid of the 2nd 100KHz IF amplifier (6BA6). The plate of this tube is connected to the B+ supply through the primary of the 4th (double-tuned) 100KHz IF transformer, the secondary of which is directly coupled to the AM detector diode (one diode in a 6AT6 tube), and capacitively-coupled to the other diode in the 6AT6 tube, which provides the AGC voltage, and also to the grid of a cathode-follower stage (6AU6) that provides a low impedance buffered IF output at 100KHz for external use, eg. by a panadapter.

The output of the AM detector is passed to the AF gain control via the mode switch when in 'AM' mode, which controls the audio signal level being fed to the triode grid of the 6AT6 tube, acting as the 1st AF amplifier. The plate of this tube is capacitively-coupled to the grid of the audio output tube (6AQ5). A simple (switchable) series noise limiter (6AL5) is provided in the 6AT6 tube's' grid circuit in 'AM' mode. The output transformer has provision for 2.5ohm speaker and 600ohm (balanced) line output via a Jones plug on the rear apron of the chassis.



The three double-tuned 100KHz IF transformers (T1, T3 and T4) have variable coupling between their primary and secondary windings, this being achieved by a ganged mechanical linkage mechanism that converts rotary motion of the Selectivity control to vertical movement of actuating rods that move the primary windings in these three IF transformers: the transformer windings are slightly over-coupled for the wider bandwidth ('AM') setting (Selectivity control fully CCW), and under-coupled for the narrowest bandwidth settings of the Selectivity control - see sketch, right (note that the amount of movement of the primary winding is exaggerated in this sketch). A (normally closed) microswitch is also operated by the Selectivity control – this switch is connected across the 100KHz filter crystal, and opens when the 'N' selectivity position is selected (Selectivity control fully CW). The signal strength meter is connected in a resistive bridge arrangement in the screen circuit of the 2nd 100KHz IF tube. The RF amplifier and 1st 100KHz IF amplifier stages have separate manual gain controls, and the RF amplifier, 1st mixer, and the two 100KHz IF amplifier stages can be controlled by the AGC. The time constant of the AGC is automatically lengthened when either 'LSB' or 'USB' modes are selected, and the AGC action is delayed by the cathode bias arrangement of the 6AT6 tube.

The output of the 4th 100KHz IF transformer is also capacitively-coupled to the control grid (g3) of the self-oscillating heptode product detector tube (6BE6). When 'LSB', 'USB' or 'CW' modes are selected, voltage is applied to the screen grid (g2) of the 6BE6, and the audio output from the plate circuit of this tube is connected to the AF gain control in place of the output from the AM detector. The product detector oscillator ('BFO', or 'CIO', ie. carrier insertion oscillator) frequency is controlled by a combination of a capacitor/inductor tuned circuit in the oscillator grid (g1) of this tube, plus a varicap diode (type '100SC2'), the reverse-bias voltage on which is used to control the frequency: the slug in the inductor sets the centre frequency to 100KHz with the BFO pitch control (a pot mounted on the front panel), centred for CW operation, and two preset pots adjust the varicap diode voltage to provide fixed

+/-1.5KHz offsets for USB or LSB operation (photo, right). The front panel BFO Pitch control allows for around +/-3KHz adjustment of the BFO frequency in CW mode, and also minor adjustment of the BFO frequency in LSB or USB modes (around +/-100Hz).

In dual-conversion mode (Bands 1 through 6), the plate of the 1st mixer tube is connected to the B+ supply through the primary of the 1st IF (1350KHz) transformer, a tap on the secondary of which is capacitively-coupled to the grid of the 2nd mixer tube (6AK5). The output of the 2nd local oscillator (6C4) is capacitively-coupled to the cathode circuit of the 2nd mixer tube. The primary and secondary circuits of the 1st IF (1350KHz) transformer, along with the 2nd local oscillator, are tunable over a 200KHz span, centred on 1350KHz, this providing the 'Incremental Tuning' facility on Bands 1 through 6.

The crystal calibrator operates at 100KHz, and when it is switched on, by a momentary action toggle switch, the RF amplifier stage of the receiver is desensitized to allow the (weaker) high-order harmonics of the calibrator to be heard. The output from the calibrator is loosely-coupled into the 1st mixer stage grid.

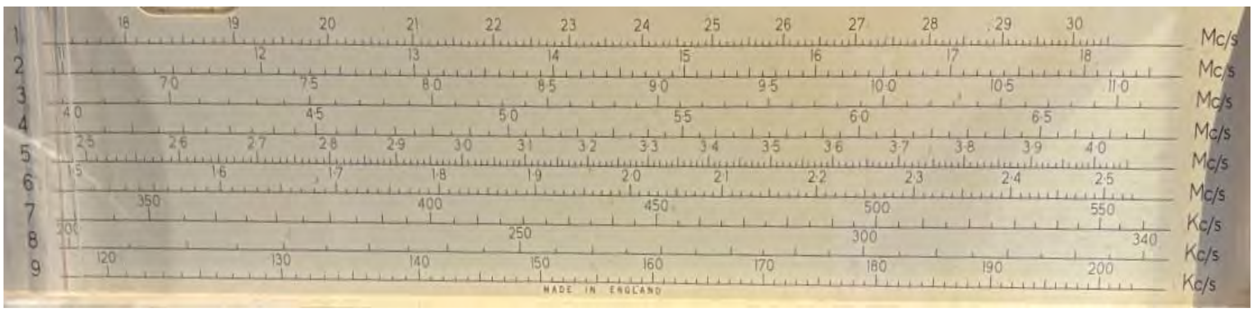
The power supply comprises four silicon rectifiers (type 'DD006') in a half-wave arrangement (two diodes are wired in series to increase their PIV rating), and this provides four B+ voltage supply lines: one unregulated 240vDC (general) B+ supply, 2 x 150vDC supplies - these being regulated independently by two OA2 tubes, and provide plate and screen voltages to the local oscillators and screen voltage to the product detector, and an unregulated 200vDC supply, providing the plate voltage to the product detector and 1st audio stages. The power transformer includes three 6.3vAC centre-tapped heater windings, though one of these is not used. One of the heater windings supplies only the 6AL5 noise limiter tube, and the centre tap of this winding has a small positive voltage on it, derived from a voltage divider from one of the 150vDC supplies, to mitigate hum induced from the cathode of the 6AL5 tube. The heater supplies are coupled into the circuit via connections in a 12-pin Jones socket on the rear apron of the chassis – this allows for an external supply to be connected, but also means that jumpers must be installed in a mating Jones plug for the set to operate (or shorting wires on the rear of the Jones socket).

Mechanical Construction

The S830 sets have a very robust construction, mainly of heavy-gauge painted steel – photo, right. The Appendix includes above and below chassis layout diagrams.

The chassis comprises the following major components: pressed-steel side panels, front panel (cast aluminum), 2nd IF/AF (pressed steel) sub-chassis, power supply (pressed steel) sub-chassis, coilbox (cast aluminum with steel cover plate), 2nd mixer/2nd local oscillator sub-chassis (painted brass plate), calibrator (painted cast aluminum), tuning gang cover (pressed steel), rear apron (steel), and a one-piece welded steel cabinet with inset perforated steel sections to provide ventilation. The front panel is attached to the front of the coilbox with four tapered 0BA screws. The painted/silk-screened aluminum fingerplate, drilled for the various control shafts to pass through, is attached to the front panel with double-sided sticky tape and several of the control pot securing nuts, and must be removed to access the tapered bolts if the front panel needs to be removed.

The 2nd mixer/2nd local oscillator sub-chassis is mounted on the top side of the power supply chassis adjacent to the power transformer, and the calibrator unit is mounted on the top of the tuning gang cover. The product detector components are mostly located in a screening can mounted on the top side of the 2nd IF/AF sub-chassis, along with the four 100KHz IF transformers and the (fully-shrouded) audio output transformer. The B+ filter choke is located on the underside of the power supply sub-chassis.



The main tuning scale (photo, above) is a large and impressive slide-rule dial with a vertical plexiglass pointer (cursor), which runs on two brass guide rails. The main tuning mechanism (when not worn and when adjusted properly), is silky smooth in operation, and comprises a friction drive and brass gear arrangement driving two plastic spool pulleys that are connected to a metal dial cord. The Incremental Tuning mechanism is a brass gear train, coupled both to the 1st IF transformer/2nd local oscillator tuning gang, and the circular Incremental Tuning indicator dial, this being visible through a cut-out at the centre-top of the main tuning scale. The 'Peak RF' trimmer gang is connected to the front panel control via a flexible (neoprene) belt. The (rotary) mode and AGC/noise limiter switches are mounted on brackets bolted to the 2nd IF/AF and power supply sub-chassis respectively.

Stout chrome-plated steel carrying handles are bolted through either end of the front panel and these bolts secure the front panel to the side plates of the chassis, these also being bolted to the outer sides of the 2nd IF/AF and power supply sub-chassis, the opposite sides of which are bolted to the sides of the coilbox. Two removable side 'cheeks' form part of the front panel, either side of the main tuning dial – these are removable, along with the dial light securing strip, to allow for the dial cover glass to be removed for cleaning without further dismantling of the set.

Controls

The front panel controls (photo, top of page 6) comprise: RF gain, IF gain (these are concentric on the same shaft), BFO Pitch, 'Wavechange', Crystal (1st local oscillator VFO/crystal) select lever, Cal. (crystal calibrator momentary toggle switch), Peak RF (this trims the antenna, RF amplifier, and 1st mixer stage tuned circuits on all bands), (main) Tuning, Incremental (tuning), AF gain, Selectivity (AM/SSB/CW/N), Mode (AM/CW/USB/LSB), AGC/Noise Limiter, Mains toggle switch (power), and a high-impedance ¼" jack 'phones socket that defeats the speaker when a jack plug is inserted. A small knurled metal knob at

the top left of the front panel allows for minor mechanical correction of the pointer position on the main tuning dial. The signal strength meter is visible through a cut-out on the upper left of the main tuning dial, and the signal strength meter zero adjust preset is located on the rear apron of the set.

Initial Testing and Inspection

This example looks to have had a hard life since it left the Eddystone factory (in July 1963 according to its Serial No. 'GO0844'[5] – photo, below). It was not in the best cosmetic shape, with a rusty cabinet, missing/ broken/'mongrel' knobs (photo, right), and a full compliment of deceased arachnid residents, however, it looks to be complete, so I figured that it should be a reasonable candidate for refurbishment.

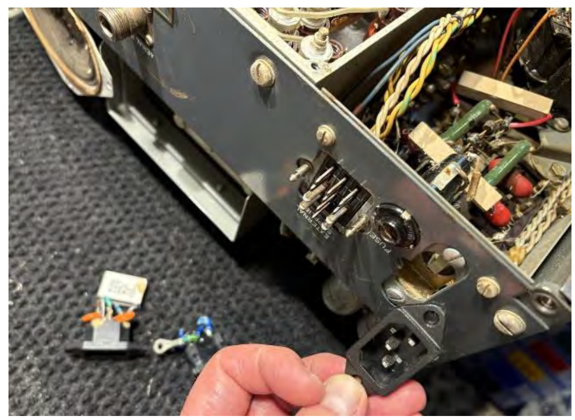
From correspondence with the owner, my understanding was that he would like a fairly comprehensive job done on this set, so it would be on the bench for a few weeks as my primary 'summer project' for 2026.

With the set now on my bench and its case removed, I took the coilbox cover plate off to inspect the RF amplifier, 1st mixer and 1st local oscillator compartments (photo, right). These looked untouched, with many 'tired-looking' components present (like the rest of the chassis!). The usual 'suspects' were there - including the nasty little 'Dubilier'-brand grey plastic-encapsulated paper capacitors in the RF, 1st mixer and 1st local oscillator compartments – in my experience, these are almost always either very leaky, open circuit or way off

[5] July, 1963 contradicts the S830/4 production dates noted in the UQRG (1965 – 1967), and one of the Plessy filter capacitor cans is dated March 1965, so the set was likely produced shortly after then, not in 1963. The Eddystone factory was known as the 'Bathtub', a former 'lido' holiday facility with a large outdoor swimming pool – hence the nickname, located in West Heath, Birmingham, UK. It closed in 1996 after 56 years of production, the company moving to a new location in Selly Oak, also in Birmingham. For more information on the Eddystone company, see here

their nominal capacitance values after six decades... I suspected that many of the resistors would also be way out of tolerance – that said, out of tolerance resistors, even up to 100% high in value, can often make little noticeable difference to the performance of a tube radio (depending on their function in the circuit of course), however, I know that when the two 100Kohm ones in the cascode RF amplifier stage of the S830 series do this, the set becomes very 'deaf'.

I noted that the band change wafer switch contacts were very tarnished (as usual) – photo, right, but at least the coilbox looked complete and should refurbish ok.



Next, I checked the power transformer primary and high voltage secondary windings, as well as the B+ filter choke for continuity, and they measured ok. I also cut off the old power cord (photo, left) and found a chassis mount (male) IEC socket to install on the rear apron in place of the original 'kettle' power connector. The IEC socket (photos, right) was salvaged from an old computer power supply and these, when installed behind the existing chassis cut-out, fit perfectly without any metalwork needed, with just enough clearance to insert (most) IEC plugs into.

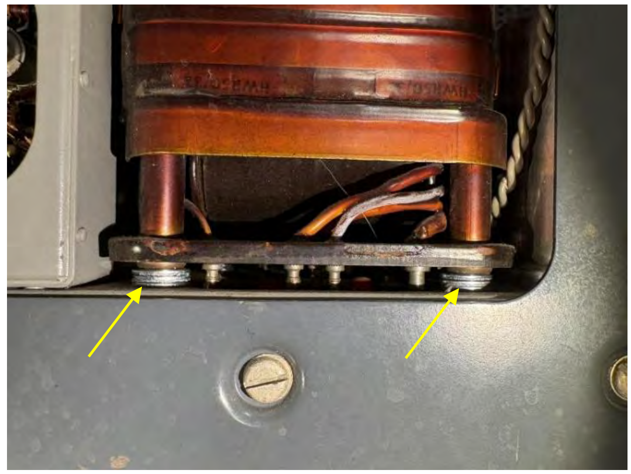
Initial power-up Test

After wiring-in the IEC socket and changing the line fuse to a 2A fast-blow part (a 5A slow-blow fuse was installed), I made a few resistance measurements between critical circuit nodes and snipped one of the leads of a damaged electrolytic (bypass capacitor in the audio section, so not a critical part). Satisfied that nothing 'untoward' was present after doing this and a further close visual inspection, I decided to try powering-up the chassis slowly (over around 10 mins in approx. 25vAC increments) using a Variac to allow the B+ filter electrolytics to re-form - they usually do so in Eddystone sets in my experience, however, after 60+ years should probably be replaced anyway.

The set 'came alive' at around 95vAC line voltage, and was bringing in some stations at the upper end of the Broadcast band (on the lower-end of Band 6), and WWV on 10MHz (Band 3), using a small internal active magloop as the antenna. All controls seemed to work reasonably well, albeit with some 'scratchiness', and the dial pointer kept sticking around half travel along the dial. At least I now knew the set was viable and well-worth proceeding with the refurbishment.

Refurbishment

Power Transformer 'Uplift'



Before starting on the main refurbishment work, I decided to raised the power transformer around 1/4" above the chassis by installing spacers (tips of arrows in photo, right) – I do this on any S830 sets I work on as it allows improved ventilation (heat convection) of the power supply compartment. This small (easily-reversible) modification is fairly easy to do and makes a lot of difference[6]. I also checked the wiring of the 'External Supplies' plug - it was wired correctly, however, the cover of the Jones plug did not have the usual fishpaper insulation present. As there is B+ voltage present in this plug, I decided to install some fishpaper as a precaution. I then wired-up the 'Outputs' Jones plug for the speaker (2.5ohm) output, as the jury-rigged internal speaker someone installed at some point in the set's life would likely have to go(!).

Initial Chassis Cleaning

I then spent some time cleaning the chassis as it was in a rather filthy state - decades of accumulated grime, as well as the deceased arachnids and their web residues (and I really dislike working on dirty chassis!). First, I removed all tubes and tested them on a STARK 9-66 transconductance tube tester (all good), and then removed the tuning gang cover/crystal calibrator unit, as well as the cover plates from the 2nd local oscillator/2nd mixer sub-chassis. Next, I spent best part of two hours with Q-Tips, rags and swabs soaked in either 50% IPA, 99% IPA or naphtha, as appropriate, to remove the grime from the top of the chassis, antenna tuning trimmer mount/trimmers, tuning gang and its cover. After this, the chassis looks much more presentable, though I planned on re-visiting some parts later, eg. the tuning mechanism and tuning gang, for further cleaning/lubrication.

I also removed the rack 'ears' from the Eddystone chassis as these have very sharp corners and tended to catch on things (including me!) as the chassis was manipulated on the bench. Of course, this was 'easier said than done' as the screws were stuck tight and required a lot of manipulation to remove them.

Power Supply Re-Build

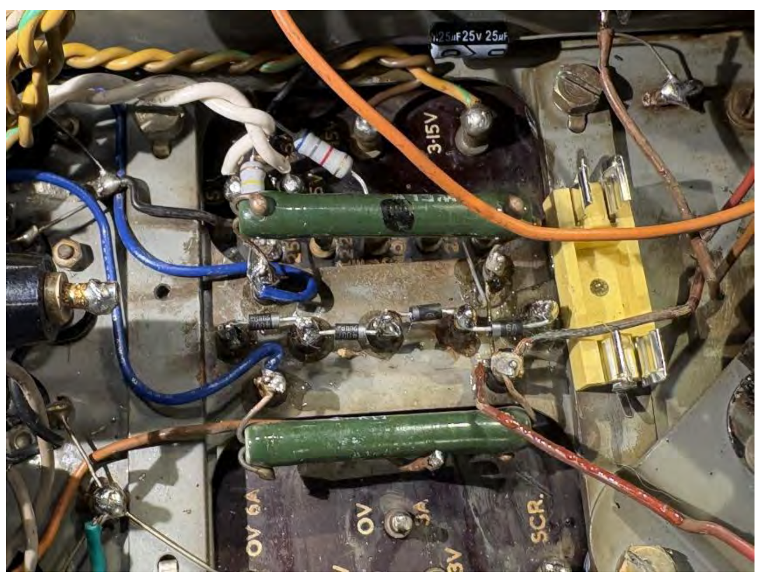
As usual, I decided to start by rebuilding the power supply section. During the preliminary cleaning and inspection work, I had noted that the insulation on several wires had 'burnt to a crisp' and was chipping off when the wires were moved slightly. I had also noted that the two 140ohm 10W surge-limiting resistors between the power transformer B+ secondary winding and the rectifier diodes had been

[6] All components and wiring in the power supply compartment of this, and most other S830 sets, are really 'baked' and will need to be replaced. This is due to these sets often being operated 24/7 for many years (in some cases, decades!), with the heat generated by the four power resistors present under the chassis in the power supply compartment being trapped due to no allowance for convective air flow in the design

replaced previously by someone, but with 100ohm 10W parts. This would not make much difference to the B+ voltage or to the surge current through the rectifier diodes, but I decided to change them out for new 150ohm 10W parts anyway, and replace (almost) all other resistors and capacitors in the power supply as the originals were very 'baked'-looking and/or were out of tolerance. The two remaining porcelain-bodied 3.3Kohm 6W power resistors (dropping resistors to the two 150vDC B+ voltage stabilizer tubes) looked in good shape and measured within tolerance, so would be left in place.

The next job was to remove some of the original/replacement parts and wiring to allow better access to the terminal posts that they are attached to (or that they obscure), and undertake some more chassis cleaning and repair work on the terminal posts. Unfortunately, Eddystone did not use ceramic-body terminal posts, and the plastic bodies of the ones used have often been heat-damaged, as had some of the ones in this chassis. Unless they have completely disintegrated, and therefore must be replaced, I have had success repairing these by thoroughly cleaning them with IPA and then adding a thick coating of 2-part epoxy around the plastic body, allowing the epoxy to flow slightly onto the surrounding chassis (also cleaned with IPA).

Once set, the terminal posts are secure and probably stronger than they were originally - such terminal posts I repaired like this 20 years ago are still holding up fine. I gave all the terminal posts in the power supply compartment this treatment, and also epoxied a fuseholder onto the underside of the chassis adjacent to the B+ filter choke - this to be wired into the circuit between the rectifier diodes cathodes and the B+ filter choke/reservoir capacitor node as additional protection for the power transformer. I also replaced one of the twisted heater wire pairs - running from the power transformer to the Jones plug on the rear apron - as the baked insulation on this was flaking off the conductors near the connection with the power transformer.



With the epoxy set on the terminal posts, I replaced the wiring between the two (OA2) voltage stabilizer tubes to their 3.3Kohm dropper resistors as the insulation on these wires had also been heat-damaged and was flaking off. With those wires replaced, I then changed-out the two resistors forming the DC voltage divider from one of the 150v stabilized power supply rails to the centre-tap of the 6.3vAC heater supply to the noise limiter tube (6AL5 dual diode). This tube type is known for inducing hum into low-level audio circuits, such as in a noise limiter circuit. The hum is indued from the AC heater to the cathode elements within the tube. To mitigate this in the S830 circuit, a small positive DC bias is applied to the 6.3vAC heater supply via the dedicated noise limiter tube heater winding centre-tap on the power transformer - the purpose of the resistive voltage divider here. The original carbon composition resistors forming the voltage divider had been cooked to a 'crisp' and definitely needed replacement. I also replaced the 25uF 25vw electrolytic that grounds the centre tap to AC - the old Plessey part was well past its 'use by date'.

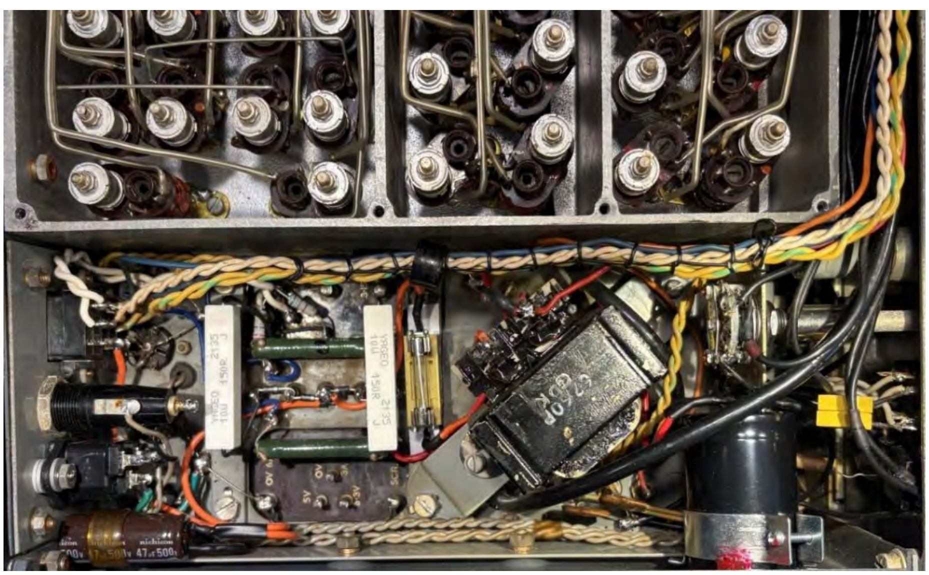
Next, I installed four new rectifier diodes in place of the originals. Eddystone used two diodes in series in each leg of the full-wave rectifier circuit, this to increase (double) the overall PIV rating of the diodes, as the spec. of the original parts (Lucas-manufactured 'DD006') was marginal for the voltages involved (400 PIV, 0.5A), especially allowing for any voltage spikes in the line supply. I replaced the rectifiers with 1N4007 (1000 PIV, 1A) parts - although there is no need to double-up these rectifiers due to their higher PIV rating, I did anyway as they only cost a few cents each. The photo on page 9 shows these component replacements.

Although the original (Plessey-manufactured) B+ filter capacitors appeared to be working ok - typical of Eddystone sets of this era - I decided that in the interests of long-term reliability, these should be removed from service, ie. disconnected, but left in place on the chassis for cosmetics, and replaced in the circuit with modern parts.

I used a single 47uF 500vw Nichicon-manufactured part for the B+ reservoir capacitor, and a dual 32uF 500vw JJ-manufactured part for the B+ smoothing capacitors. I mounted the 47uF capacitor in a plastic clamp (recovered from another Eddystone set some time ago), bolted to the underside of the chassis near the rear of the power supply compartment, and the dual 32uF capacitor using a metal clamp, again on the underside of the chassis, located between the B+ filter choke and the front of the chassis. I used the existing 2BA bolts to mount these parts, and an additional 2BA bolt epoxied to the inside of the chassis side plate for the second mounting lug on the metal clamp.

With these capacitors installed, the remaining work in the power supply mainly involved wiring, plus the installation of the two 150ohm 10W resistors and two Y2-Class safety capacitors on the 120vAC line input, these wired between live and neutral to ground on the switched side of the wiring to the power transformer primary winding[7].

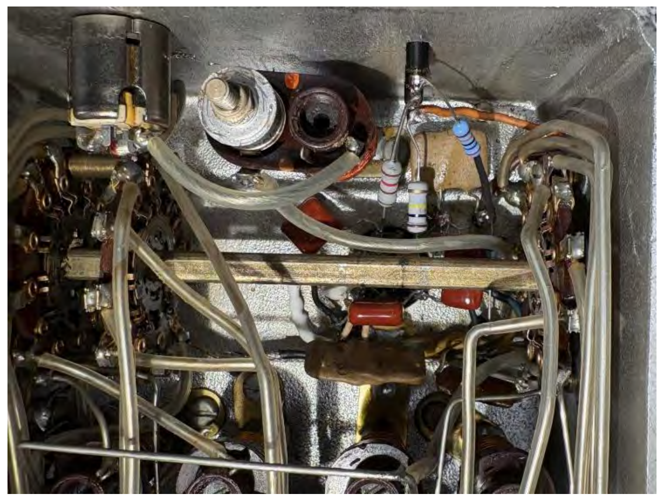
With this completed, I installed a 250mA slow-blow fuse cartridge into the B+ supply fuseholder, reinstalled all the tubes, and powered-up the receiver using a Variac. With 117vAC line voltage, the B+ supply measured 242vDC and both stabilized supplies measured 150vDC, so all working to spec. The photo, left, shows the power supply compartment after completing the refurbishment work described above.



[7] These capacitors, acting as suppressors for any RF entering/leaving the receiver via the line supply, were not in the original S830/4 circuit, this function being performed by two 0.05uF capacitors from the 'hot' ends of the B+ secondary winding of the power transformer to chassis ground instead. However, this is a potential 'disaster waiting to happen' if one of these capacitors fails, it could result in serious damage to the power transformer. These capacitors are not present in several other S830 variants.

I left the chassis running for an hour or so and then took some thermal images under the chassis (the Appendix includes a selection of thermal images). Nothing appeared untoward, with, as expected, the hot spots being the four power resistors in the power supply section: the two 150ohm 10W resistors each running at around 128C, and the two 3.3Kohm 6W voltage stabilizer dropper resistors, each running at around 139C - both well within normal temperature ranges for such parts. This is testimony as to why things can become very 'toasty' in there! - the additional ventilation measure of lifting the power transformer above the chassis by 1/4", plus careful components placement and lead dressing within the compartment, will mitigate such heat-related issues in the future (and, of course, I doubt the set will be run 24/7 for years on end in its ‘future life’...).

RF Amplifier, 1st Mixer and 1st Local Oscillator Stages



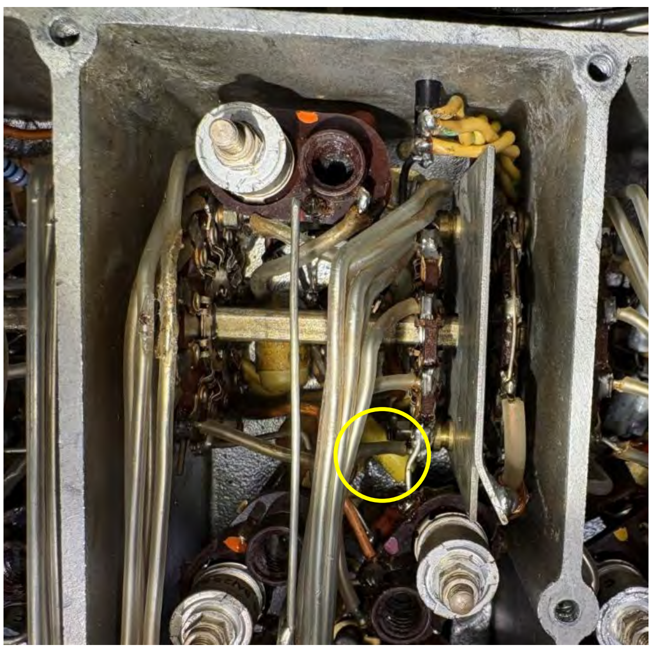
I replaced all resistors and non-ceramic/silver mica capacitors in the RF amplifier stage (photo, right), and all resistors in the 1st mixer stage, apart from the coil damper resistors (I checked a couple of these low-value parts and they were within tolerance), did some wiring replacement, and cleaned some of the band change switch wafers and contacts. I also changed-out the hidden Dubilier 0.01uF tubular paper[8] coupling capacitor between the 1st local oscillator and 1st mixer compartments - this has to be one of the hardest to replace parts in any radio(!): an extension wire from one lead of this capacitor extends from the plate (pin 6) of the 1st local oscillator tube (pentode section of a 6U8) through a small, almost invisible, hole located between the two compartments, located behind one of the band change switch wafers in the 1st local oscillator compartment and behind another switch wafer on the 1st mixer side of the compartment divider, these totally obscuring the hole.

This 1st local oscillator and 1st mixer coupling capacitor body is often jammed between the screening plate that is located between two of the band change switch wafers in the 1st mixer compartment and the underside of the die-cast coil box (as was the case here), making extraction very difficult. The trick for its successful extraction/replacement is to solder a length of thin Teflon-insulated[9] wire to the end of the original capacitor lead that connects to pin 6 of the 1st local oscillator tube socket, after first unsoldering the lead from the tube socket. The end of the capacitor connecting to pins 2 and 7 of the 1st mixer tube is then unsoldered, and pulled - if you are lucky, the capacitor is not jammed in place and the Teflon-insulated wire will be pulled through the hole as the capacitor and original capacitor lead is pulled from the 1st mixer compartment. If you are unlucky, as I was in this case, the capacitor body will be jammed and the capacitor lead you are pulling will detach from the capacitor(!). If this happens, as it did for me, the mounting screw of the adjacent coil former assembly (L17/C43) can be loosened, and the

[8] In some S830 sets, small ovoid-shaped paper capacitors were used in place of the Dubilier types (these resemble rat poop in shape and, after many decades, are about as good as that material as capacitors!

[9] Teflon insulation is both tough (resistant to scuffing/tearing), and smooth – this mitigates the possibility of the wire being damaged/snagging as it is pulled through the hole

stiff wire connecting it to the nearby band change switch wafer unsoldered. This allows a little extra room to insert dental tools and forceps down the side of the coil former to manipulate the capacitor from where it is jammed, and then extracted - hopefully pulling the Teflon-insulated wire along with it (photo, right). Once the Teflon-insulated wire is through the (hidden) hole, a new 0.01uF capacitor can be soldered to it and insulated with some heat-shrink tubing, and the other capacitor lead soldered onto the 1st mixer tube socket (pin 2, cathode), with the other end of the Teflon-insulated wire connected to the 1st local oscillator tube socket (pin 6). The photo, left shows the refurbished 1st mixer stage compartment with the replacement coupling capacitor (yellow bodied part) circled.

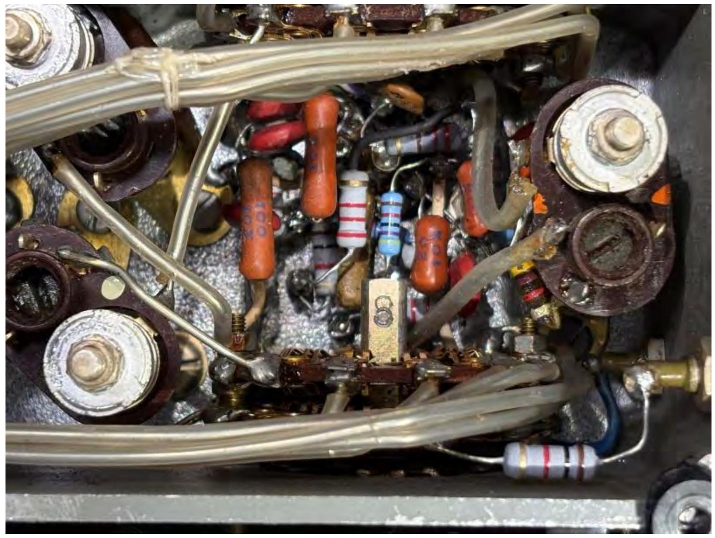


A solid block of time is recommended for working on changing out the resistors and tubular paper capacitors in the 1st local oscillator compartment (it takes me almost 3 hours) as lots of 'focus', pre-planning and careful pre-installation lead dress/insulation is needed, as several parts are hidden under two layers of other parts, space is very limited, and component wires cross over each other. A tip when undertaking work like this is to leave each removed component on the bench until its replacement has been installed, then throw it in a container (not the bin), as this acts as a double-check that nothing has been omitted during installation of the new parts - its all too easy to be distracted and miss something (I know, as I have 'been there'!). Keeping the removed parts in the contained until the work has been checked also helps to reassure nothing has been missed. Also, it helps to undertake some preparation work for the component replacements in the 1st local oscillator compartment, eg. unsoldering a couple of wires to the L13/C13 assembly and temporarily moving several of the thick wires connecting the oscillator coils to the band change switch, to provide better access.

The five tubular paper bypass capacitors and one coupling capacitor in the 1st local oscillator compartment were replaced by small 500vw disc ceramic parts[10], and I used a mix of 1W and 1/2W

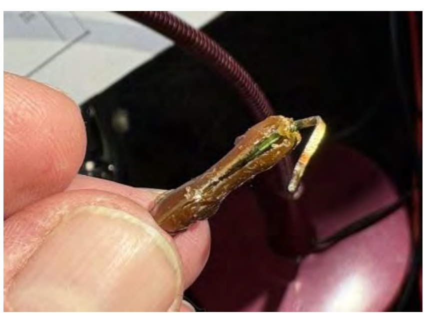
[10] Disc ceramic capacitors are good in RF bypass service and are often physically smaller than the equivalent capacitance/voltage rating plastic film parts

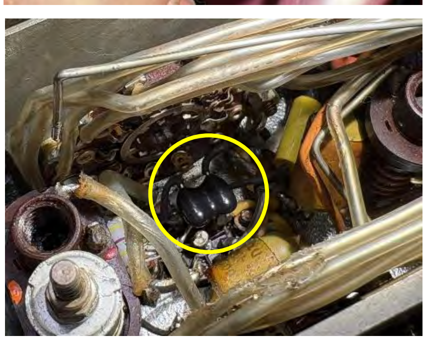
resistors. The 1/2W parts were used only for the grid resistors, where negligible power is dissipated, to provide a better physical fit in the cramped space available. The photos, right, show the refurbished 1st local oscillator compartment before and after re-installing the band change switch shaft and coupler.



After completing work on these three stages, I left the chassis on the bench to recover from the 'trauma' for the rest of the day (or was that me that had the trauma!), and returned to it later with 'fresh eyes' to check my work: it is very easy to make a mistake(s) when several parts have to be removed at once to provide access to replace other parts, even with continuously cross-checking against the schematic as I did during all component replacement work on the chassis.

With 'fresh eyes' (the next day), I spent some time carefully checking and re-checking the location of every new component installed in the RF amplifier, 1st mixer, 1st local oscillator and the 2nd local oscillator/2nd mixer compartments visually and with resistance measurements, looking for any issues. I did not find any errors, but noted that the band change switch shaft had been catching on a wax-coated 100pF silver mica coupling capacitor in the 1st mixer stage (probably since the set was new!). On closer inspection, I noted that the wax coating was splitting along the edge of the capacitor (photo, above left), where the switch shaft was contacting it, thus compromising its ability to keep moisture out of the part. Given this, I decided to remove the capacitor and replace it with a new 100pF epoxy encapsulated siler mica capacitor (circled in the photo, below left). I then re-checked lead and component dress in each of the compartments and made sure that no other components would contact the switch shaft.





2nd Local Oscillator, 2nd Mixer and Tunable 2nd IF

Work in the 2nd local oscillator, 2nd mixer and tunable 2nd IF compartment is much more straightforward than that in the RF sections of the chassis. I replaced all the resistors and tubular paper (Dubilier) bypass capacitors, a wax-coated silver mica capacitor that I accidentally melted the wax on with a soldering iron (oops!) - the capacitor tested ok, but I changed it out anyway, plus I replaced a wire that was fraying at one end. The photos, right, show the 2nd local oscillator, 2nd mixer and tunable 2nd IF compartment before (above), and after (below) refurbishing.

I tested several of the parts after removal: as usual, the Dubilier tubular paper capacitors were 'all over the map' regarding capacitance and leakage, so definitely needed replacing. Most of the resistors were only marginally outside tolerance, though two measured 50% above their nominal values.

Next, I powered-up the chassis and confirmed that the receiver was functioning in both single conversion (Bands 7-9) and double-conversion modes (Bands 1-6) - it was, with no 'spurii' noted on any band. I left the chassis running for around an hour, and then took some thermal images of all areas of the chassis - no issues were noted.

With that, until I carried out further cleaning of the band change switch contacts and undertook the realignment work, I decided to 'call it a day' on the RF sections through to the 2nd IF stages of the chassis, apart from checking the 2.2Mohm B+ bleed resistor[11] wired across the band change switch section that provides B+ to either the tunable 1st local oscillator (VFO), or the crystal-controlled 1st local oscillator when the receiver is in 'high stability' mode (up to 8 crystal controlled frequencies can be selected in place of the VFO). When checking this resistor, it appeared to be shorted out in all switch positions, whereas it should be shorted out only when the crystal-controlled 1st local oscillator is selected. I also carried out a little preparation ready to start work on the 2nd IF, BFO/product detector/AM detector, noise limiter, AGC and audio stage compartment, removing the rear protection plate/shield from the mode switch - easier said than done as the 6BA nuts were seized onto the screw threads of the pillars holding the switch together - nothing is simple....

[11] When the VFO is selected, this resistor provides a small electron flow through the crystal oscillator tube to mitigate 'cathode poisoning' effects in the triode section of the 6U8 tube

2nd IF, BFO/Product Detector/AM Detector, Noise Limiter, AGC and Audio Stages




Most of the BFO/product detector circuitry is contained in a screening can with the tube mounted on top of this can[12], the unit being located above the 2nd IF/audio section of the main chassis in this model. To service this unit, the connections to it must be unsoldered and the unit removed from the main chassis. The screening can is then removed from the internal metal frame, allowing the components and wiring inside to be inspected/changed-out as needed. True to form, the Dubilier tubular paper capacitors in this unit were 'all over the map' on value and leakage, the 25uF electrolytic was effectively an open circuit, and some resistors measured over 50% above their nominal values. Amazingly, the unit was still working reasonably well - it always surprises me how tolerant tube circuitry can be to failing/failed components(!).

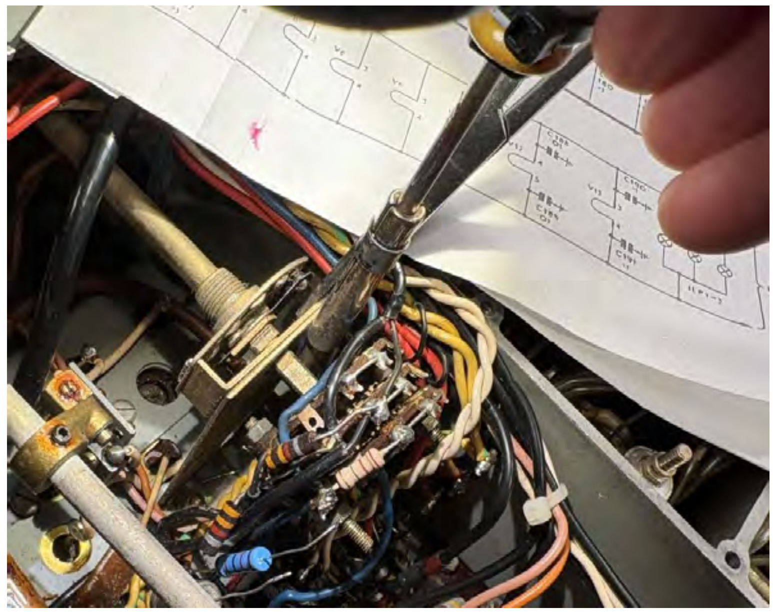
I decided to replace all the paper capacitors, the electrolytic, and all resistors in this unit, as it is 'PITA' to remove and re-install the unit if another part needs replacing at a future date. The tubular ceramic and the single polystyrene dielectric capacitors in the unit were left in place as these are generally very reliable, as was the varicap diode. After double-checking the components and wiring after replacement, the unit was reassembled and installed back onto the chassis and tested - it was working well on CW, LSB and USB settings. The photos above show the internals of this unit before (above) and after (below) refurbishing.

Next, I completed replacing the remaining components in the product detector/BFO circuit (external to the above-chassis screening can), the three-wafer mode switch (AM/CW/LSB/USB), crystal calibrator switch, RF/IF gain controls, and the two 2nd IF stages. Again, I replaced all resistors and tubular paper

[12] Several other Eddystone models have their BFO circuit mounted in a similar unit located above the chassis

capacitors. I tested the metal-encapsulated solid tantalum 10uF 35vw (slow) AGC timing capacitor - it measured almost exactly 10uF and had no measurable leakage, so I left this part in place[13].

The most time-consuming part of this piece of the work was replacement of a 100Kohm resistor on the underside of the front wafer of the mode switch. In previous S830 refurbishments, I have removed the entire switch and its mounting bracket, plus several of the wires and components leads connecting the switch into the circuit, so the switch could be turned almost upside-down to access this part. This is very time-consuming and potentially prone to making errors when reconnecting the wires and component leads. This time, I thought I would try a different approach - loosening the two threaded studs that hold the switch wafers to the mounting bracket and the switch detent mechanism, this allowing all three switch wafers to be eased rearwards. This worked ok, leaving just enough space between the mounting bracket and the front switch wafer to remove the original 100Kohm resistor and install a new part (I had to use a 'pencil' soldering iron for this though – photo, right). Reassembly of the switch was very straightforward (and quick!), as only two component leads needed to be temporarily removed. I think this approach saved quite a bit of time and I would do this again on any future S830 series sets.



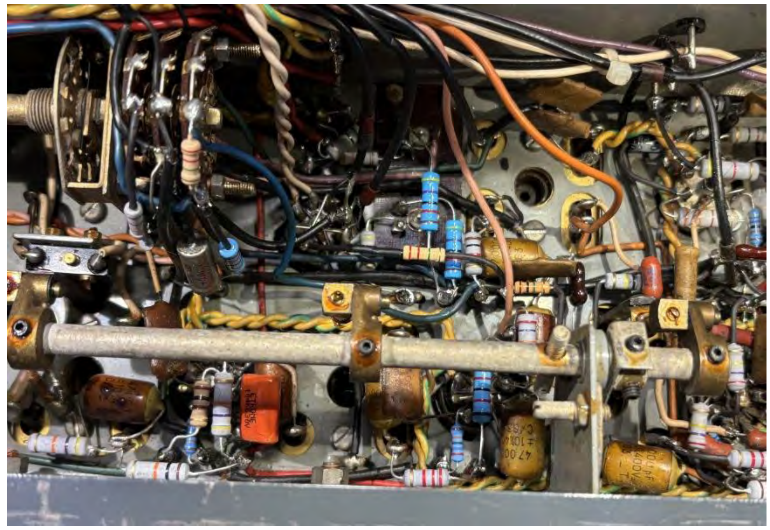
On checking and double-checking the above component replacements with 'fresh eyes' the next day, I found no errors, so powered-up the set to check it was still functioning ok - it was, and I noted that a strong local station at the upper end of the Broadcast band (lower end of Band 6 on the S830/4) was around 3 divisions stronger on the set's signal strength meter - probably the result of replacing several significantly out of tolerance resistors (and two that were open circuit on the RF and IF gain controls!). I left the set running for half an hour and than powered it down to start on the next refurbishment steps.

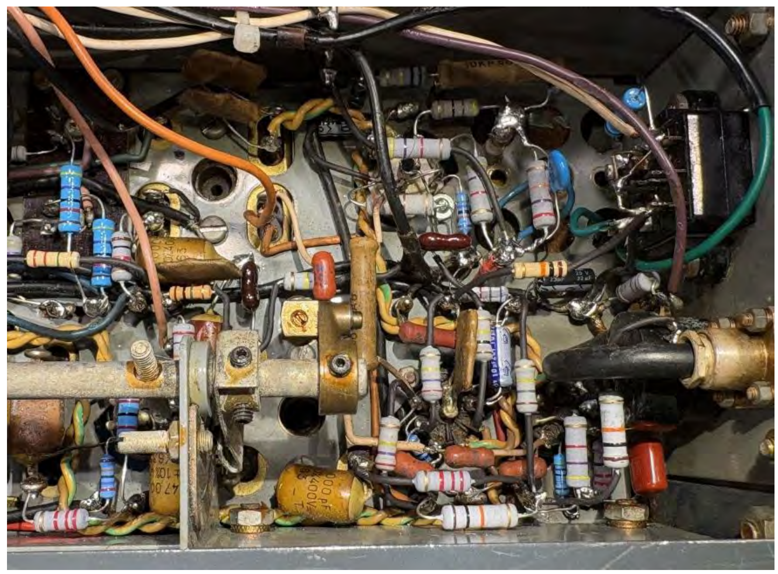
Next, I replaced all tubular paper capacitors, electrolytics and one tantalum bead capacitor (a previously replaced part that was originally an aluminum electrolytic), and all resistors in the AM detector, AGC, noise limiter and audio stages. I also replaced the 3Kvw 5000pF disc ceramic capacitor across the audio output transformer primary - it tested ok (though its measured capacitance was a little low at 3270pF), but it looked very scruffy and out of place amongst all the new parts.

These circuits, as are several other in the chassis (and many other Eddystone models), have been constructed in layers (often three), making the logistics of undertaking the replacements somewhat time-consuming. Also, I like to keep the component and lead dress as good (if not better) than Eddystone did originally - they liked to keep the component orientation parallel or at 90 degrees to each

[13] Solid tantalum capacitors like this have high reliability and their low leakage, compared with aluminum electrolytics, is needed in the (high impedance) AGC circuit, where even small amounts of leakage can result in poor AGC performance

other and the sides of the chassis whenever possible (looks very neat and tidy). The photos, right, show the 2nd IF, BFO/product detector/AM detector, noise limiter, AGC and audio stages after refurbishing. Doing this, and adding heat-shrink on many of the component leads to mitigate potential shorts if the wiring is disturbed at some point, also added to the time to undertake the work. I think the end result is worth the effort - not only visually, but it also makes future servicing much easier than the usual 'rats nest' of bent and twisted leads and solder globs after years of ad-hoc component replacement and folks tinkering with the circuit... as was the case in this chassis.





Most of the resistors in this section of the circuit were out of tolerance by 10% to 20%, though some by as much as 300%, and the capacitors were also failing, with the exception of the tantalum bead (but I replaced it anyway). I also replaced one of the very reliable Mullard/Philips (Mylar film) 'mustard' capacitors as one of its leads was 'wobbly' where it entered the capacitor body - it still tested ok, but better replaced to mitigate potential future issues. The two 500pF Dubilier tubular paper capacitors in the IF filter after the AM detector were replaced with silver mica parts.

Again, with 'fresh eyes' the following day, I checked and re-checked all the component replacements I made in the detector/AGC/NL and audio stages. All was in order, so I powered-up the chassis and checked its performance. I was pleased to find that the audio sounded so much better than before - previously the audio had sounded a bit 'muddy' and slightly distorted, now it was as 'clear as a bell'.

One of the strange 'quirks' of the S830 circuit is that quite often audio can still be heard even when the AF gain control is at minimum. This can be due to several factors, including the actual 6AT6 dual diode/triode tube[14], and/or insufficient audio decoupling of the 6AT6 cathode circuit. The latter is an

[14] Some makes/production runs of the 6AT6 tube have sufficient stray internal capacitance coupling between the diode and triode sections to allow audio from the AM detector diode to be coupled to the triode grid and cathode, resulting in some unwanted audio breakthrough even when the AF gain is at minimum

artefact of the design of the cathode circuit, where a voltage divider is included in the cathode to provide delayed AGC voltage, and this uses two electrolytics for decoupling, one 10uF and one 25uF, effectively in series, thus having a combined value of only around 7uF. When this issue is present, I have found that adding a large, say 470uF, decoupling capacitor directly from the cathode of the 6AT6 tube to ground mitigates this breakthrough, with no noticeable side effects. I noted only very slight audio breakthrough on this chassis with the standard circuit - this was at an acceptable level without this (easily reversible) mod being undertaken.

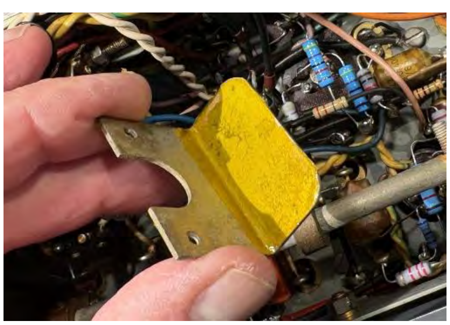
I left the chassis running for an hour and took some thermal images of the AM detector/AGC/NL and audio stages, plus some of the 2nd IF and product detector/BFO stages, The hot spots were, as expected, the 2W resistors, though all were within normal operating ranges for these parts.

Crystal Calibrator

The crystal calibrator is built into a small Eddystone aluminum die-cast box located above the tuning gang cover, and must be removed to access the components. I replaced the three resistors and one (Hunts) tubular paper 0.01uF (screen bypass) capacitor located in this unit. I found that the screen resistor to the 6AU6 tube measured around 40% high of its nominal value, and its bypass capacitor was leaking over 3uA at 300vDC, and measured around 30% high of its nominal value. The photos, right, show the crystal calibrator unit before (above) and after (below) refurbishing.

More Cleaning and Lubricating

Following completion of the majority of component replacement, I undertook some further cleaning of the band change and mode switches with Deoxit D5, cleaned some wiring and the underside and inside walls of the chassis with IPA, reinstalled the metal screening plate on the mode switch (I added some

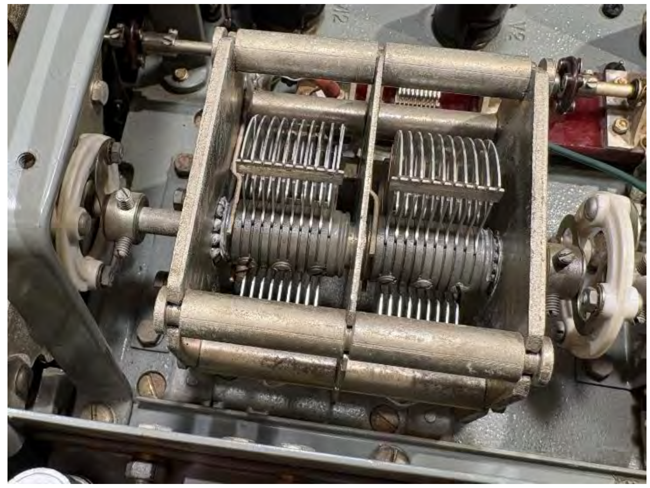


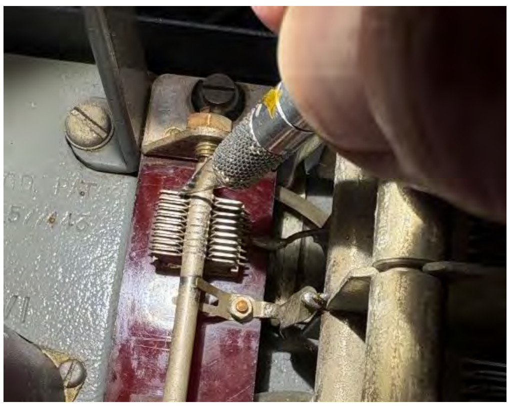
Kapton tape to its underside, photo, left, as a precaution against shorts as it is in close proximity to some of the mode switch contact lugs), replaced a resistor mounted on the 1st local oscillator VFO/crystal switch (located above the chassis), cleaned the switch contacts with Deoxit D5, and tidied-up some of the wiring, again re-testing the chassis after this work was completed. I then investigated the switch issue I had noted earlier - a 2.2Mohm resistor on the band change switch (wafer 'S1g', closest to the front of the chassis) was shorted out in all switch positions instead of only Band 7-9), however, this was now working correctly[15].

Next, I serviced the three tuning gangs: the main tuning, four section gang, the incremental tuning, three section gang, and the 'Peak RF' control, three section gang. This included cleaning out the congealed old

[15] In retrospect, I suspect I had not measured it correctly previously, as nothing had been changed in the circuitry to correct this

grease from the ball races and re-lubricating with fresh lithium grease (photo, right), cleaning the ground contact surfaces with Deoxit D5, adding a spot of light machine oil to the rear ball bearing, and cleaning between the stator and rotor vanes on all gang sections. I had noted the 'Peak RF' control was not working well, with the signal cutting out over part of its rotation - this is a common issue with this control, and is caused by incorrect setting of the rear ball bearing thrust (adjusted by a screw) and/or misaligned stator/rotor vanes on one or more of the gang sections. Close visual observation identified the





issue to be some of the vanes in the antenna section of the gang were shorting. I first optimized the setting of the rear bearing thrust, and then used an Exacto knife blade to very carefully re-set the errant vanes on the antenna section of this tuning gang (photo, left). Doing this fixed the problem.

I then removed the dial glass and cleaned it and the dial plus the (rotating) incremental tuning dial, dial pointer and the S-Meter, and then re-installed the dial glass. I noted that the dial glass rattled, so I added some thin adhesive foam to the two removable metal 'cheeks' that retain the sides of the glass - this cured the rattling. While I was rotating the incremental tuning dial as I was cleaning it, I noted that the friction clutch in the incremental tuning drive was slipping - inspection revealed that someone had added oil/grease to this mechanism(!), so I spent some time cleaning the friction drive plate and clutch with Q-Tips soaked in naphtha, after which it worked reliably.

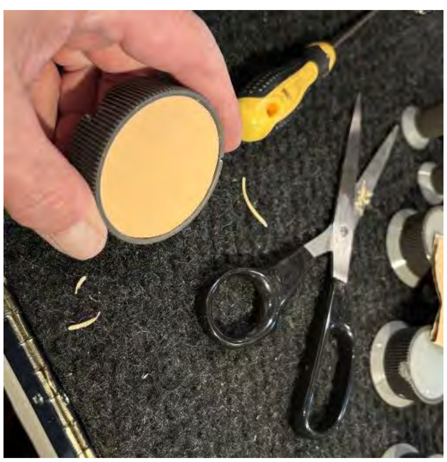
I then re-installed the tuning gang cover/crystal calibrator and tested operation of the calibrator - it was working ok after the component replacement, and re-installed the cover plates to the 2nd local oscillator/2nd mixer compartment, before putting the set on soak test for a few hours.

Cosmetics

Prior to making a start on the alignment, I decided to undertake a little cosmetic work on the front panel - mainly the knobs, several of which were in a poor state (cracks and/or chunks missing, and the large band change knob was also missing its front insert). Also, the AGC/NL knob, which should be an 'ear lobe' chrome-plated metal one ('paddle') was a non-Eddystone one that was too small and, as a result, was difficult to turn given the stiff nature of the replacement rotary switch someone had fitted for this control. One of the smaller knobs, fitted to the 'Peak RF' control, was also missing its front insert, but I found this in a bag of bits the owner had supplied with the set, so that was an easy fix to glue that back in place.

I went back to my junk box to see what I had in my Eddystone bins, and found a number of Eddystone knob styles - some were NOS, but most had been 'rescued' from sets that had NOS replacement knobs fitted by me during their refurbishment[16]. I used to have a NOS S830 series band change knob in stock, but I fitted that to an S830/2 I worked on previously. I found one (used) main tuning/incremental tuning knob (unfortunately damaged), several knobs to fit an Eddystone EC10 and similar sets, as well as some other 'oddball' Eddystone knobs. These included a large 'ear lobe' chrome-plated metal paddle knob, and a knob with two spigots on it (not sure what Eddystone model that was fitted to). Of these, I decided to use one of the (used but intact) EC10 knobs for the AGC/NL switch, as this is of similar style to the RF/IF gain control knobs on this set, albeit a little lighter in colour. This made operating this switch much easier due to its larger size than the small (non-Eddystone) knob someone had fitted previously, while not obscuring the lettering on the panel above the switch.

That left some repairs to do on the damaged knobs already fitted to the set. For this I used quick-set 'JB-Weld' as it is strong, has a similar colour to the Eddystone plastic the knobs are made from, and, about an hour after mixing and applying to the knob, can be carved/ trimmed/sanded with relative ease if needed. Sometimes several applications of JB-Weld are needed, and masking tape can be used to form a barrier, eg. along an edge, if the JB-Weld is flowing where it shouldn't until it starts to set. Also, where the damage was adjacent to a set screw access hole, I used short lengths of heat-shrink tubing to prevent the JB-Weld from plugging the hole (photo, above).



While some of the JB-Weld was setting, I made an insert for the band change knob from the top of a rigid plastic container - the insert is 2" diameter. I cut/trimmed the piece needed using scissors (photo, left), and then used sandpaper to smooth the edge and to roughen the outer surface. I then cleaned the sanded surface with IPA and primed it with grey plastic primer before spraying it with four coats of semi-gloss grey paint similar in tone to the inserts on the other knobs. Once that paint was dry, I wiped the inside of the band change knob with IPA and glued the insert into its centre - not perfect (the original insert was slightly convex, and my 'repro' was flat), but it certainly looked better than it was before.

Once the JB-Weld had set, I trimmed this on each knob as needed, and also glued in the inserts into the band change knob and the smaller knob from the 'Peak RF' control. I also used a grey felt-tip pen to do a little touch-up where I had carved the JB-Weld to provide a better colour match, and used a white infill

[16] NOS Eddystone knobs and a large variety of other genuine Eddystone parts can be bought from the Eddystone User Group (from Ian Nutt in the UK - he bought the remaining stock when Eddystone closed down its factory). I have bought several knobs and other parts from Ian over the years, and I know he has the types of knobs needed here as well as reproduction fingerplates for the 830 series in stock. I understand Ian is a very busy guy, and that his work often takes him overseas, and this can affect how responsive he is to enquiries. So, don't give up easily if you are trying to contact him - he does the Eddystone spare parts gig in what little spare time he has when he is at home!

stick to re-draw the indicator line on the band change knob perimeter. The end result was again not perfect, but at least the knobs will not fall apart now and the worst of the damage has been made much more presentable.

The fingerplate on this set is in very poor shape, with several scratches and scuffs, several being through to the underlying metal, and quite a lot of the lettering has worn off, including above the RF/IF gain controls and around the band change switch (this set has had a LOT of use!). I touched-up the worst of the scratches and scuffs, but a replacement fingerplate is really needed, so hopefully the owner will be able to obtain, or fabricate, one in the future, and obtain some knobs in better shape.

Before I re-fitted the knobs, I angled the chassis at 45 degrees to the bench (dial pointing upwards), and applied a drop of light machine oil to the metal bushings of the controls to provide a little lubrication as a couple of them squeaked when rotated. I also worked some ROCOL Kilopoise high viscosity thixotropic grease into the main tuning shaft bearing as this was showing some wear (slight rattle when rotated fast). I had used my last (repro) S830 tuning shaft bearing on the S830/2 I recently worked on, so here I used the Kilopoise to help smooth the bearing operation. The slight negative effect of this approach is that the 'famous' smooth action of the Eddystone slide rule dial is a little curtailed, but it still feels good compared to many sets (a good Eddystone slide rule dial can make the pointer cover the entire scale with around 2.5 good rotary flicks of the tuning knob – very satisfying…).

The set looked quite a bit more 'presentable' after the above effort (photo, right), however, hopefully NOS knobs of the correct type and a reproduction fingerplate can be obtained at some point to make it look really sharp, especially after the case has been resprayed or powder-coated.

As I was testing the set after all this work, the dial pointer carriage/slider detached itself from the metal dial cord(!). On inspection, it was apparent that someone had tried to solder the brass pointer carriage/slider to the metal (stranded steel) cord, but the solder had not 'taken' to the steel cord - I think my work on the dial/glass must have disturbed what little purchase it had (probably only the stickiness of the flux used!). Instead of trying to re-solder it, I used some 'shoe goo' to fix it – I found that this held the carriage/slider to the steel cord well. While I was paying the dial cord some attention, I also serviced the pointer ('cursor') adjustment control mechanism as it was seized. This control is a small knurled metal knob located at the upper right of the tuning dial which allows the pointer to be moved slightly laterally to allow minor corrections of scale errors when calibrating to 100KHz markers on the dial.

Mechanical Refurbishment of the Tuning Mechanisms and Making Case Thumbscrews

Before starting on the IF/RF alignment, I serviced the main and incremental tuning mechanisms. Like the Incremental Tuning friction drive, the drive plate on the main tuning friction drive and the spring-loaded

pinch wheel (clutch) were covered in dirty grease. I cleaned these with Q-Tips soaked in naphtha (photo, left), as well as the axles, pinions and gears, before applying a small drop of light machine oil to the bearings with a precision oiler, and did the same for the Incremental Tuning mechanism. I then adjusted the end play on the main tuning knob shaft.

With the tuning mechanisms serviced and working smoothly (or as smooth as possible given the slightly worn bearing on the main tuning knob shaft), I started to prepare the chassis for the alignment work. As I was sorting through the screws removed from the chassis to re-fit the coilbox cover, I noted that the case had been secured to the chassis with three regular machine screws instead of the 2BA knurled 'thumbscrews' that Eddystone would have fitted - the fourth screw was missing as the remnants of the original thumbscrew was jammed into one of the captive 2BA nuts fixed to the rear of the chassis side panels. I removed the remnants of the original thumbscrew, and, for convenience of removal of the case when needed in future, I decided to make some new thumbscrews using some incorrect size thumbscrews from my junk box (that were too small and had incorrect threads) and some 2BA bolts. To do this, I hacksawed off the heads of the small thumbscrews, part-drilled a hole into these and screwed in the 2BA bolts after applying some 2-part epoxy to the threads and into the holes, tightening the bolts into the holes (self-threading as the thumbscrew heads were aluminum). The photo, right, shows one of the fabricated thumbscrews.

Alignment

Preliminary Checks

I carried out my usual continuity checks between the antenna connection and ground - in an S830 set, this should be less than 0.1ohm on Band 1, with increasing resistance when switching through to Band 9, where the primary of the antenna transformer should be around 5ohms due to the increasing number of turns and thinner wire used as the frequency of the tuned circuit decreases.

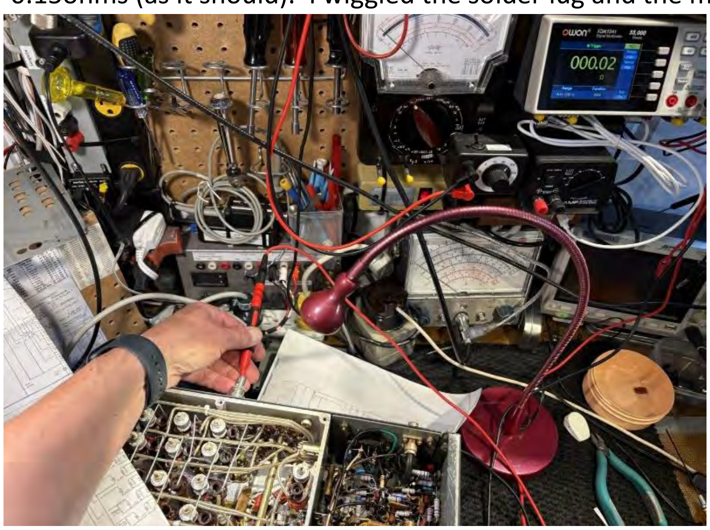
This check quickly identifies if one of the antenna transformer primary windings has been damaged, eg. from a lightening strike on the antenna, or from a transmitter being fed into the receiver antenna socket. All bands measured ok, except for Band 3, which I had previously noted seemed a little 'deaf' compared to the other bands while listening to the set during testing. Instead of a sub-1ohm reading, I was measuring varying resistance values between around 100Kohm and 700Kohm on this band - this suggested that either the primary winding was damaged or the ground connection to the 'cold' (chassis) end of the primary winding of the transformer was making poor contact (a common issue in Eddystone sets after many decades).

Antenna Transformer 'Repair'

I unsoldered the Band 3 antenna transformer/ trimmer assembly (L3/C11), removed the screw fixing its base to the top of the coilbox, and removed the assembly from the coilbox for inspection – photo, right (note that the underside view of the chassis diagram in the S830/4 manual is labelled incorrectly as 'L3/C5', whereas C5 is actually a fixed silver mica capacitor which is in parallel with the beehive trimmer (C11).

With the Band 3 antenna transformer assembly removed, I checked the continuity from the antenna to the chassis with the transformer disconnected and it measured very low resistance, indicating the band change switch contacts were ok. I also measured the resistance from the antenna socket to ground with the transformer disconnected, and this was exactly 1Mohm, which is the value of the static discharge resistor wired between the antenna socket and ground, so that was also ok.

I then measured the resistance of the transformer primary from its 'hot' end (solder lug) to the 'cold' end that is soldered to the 'foot' (metal bracket) that is secured to the chassis - this measured around 0.15ohms (as it should). I wiggled the solder lug and the mounting bracket, as well as checking the soldered joint (it looked good), and this resistance did not change significantly, indicating the likely fault was simply a poor ground connection from the bracket to the coilbox[17].



I gave the bracket, the fixing screw/washer and chassis a thorough cleaning using a wire brush and then Deoxit D5 before re-installing the transformer assembly into the coilbox. Now the resistance from the antenna socket to the chassis on Band 3 measured much less than 1ohm (photo, left) - problem solved.

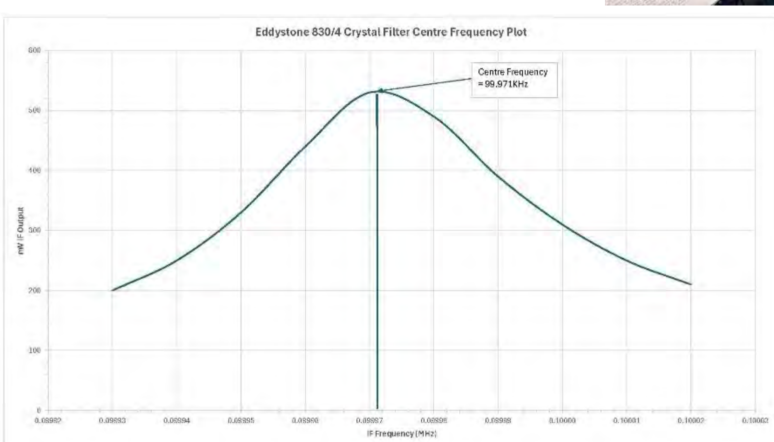
[17] It is unusual for a higher frequency transformer winding to burn out - the primary winding on this transformer looked like ~22SWG wire, so is quite thick compared to that on the lower frequency bands and would take a lot of current to fuse it

With the above work completed, I then generally followed the methodology described in the manual for the IF and RF alignment, but adapted for more modern equipment than was available in the early-mid 1960's.

2nd IF Alignment

The first step in the alignment process is to align the (nominal) 100KHz 2nd IF stages. This procedure starts by finding the series resonant frequency of the 100KHz crystal in the 2nd IF filter. This is done by setting the selectivity to 'N' (narrow), at which setting a microswitch is activated (opened) that otherwise shorts out the crystal in all other settings of the selectivity control[18]. The signal generator is then coupled to the input of the 1st mixer tube, and the (unmodulated) signal generator signal is tuned slowly above/below the nominal 100KHz IF, while monitoring for a sharp peak in the IF output level at the (buffered) IF output jack (BNC socket) on the rear apron of the chassis using an AC voltmeter[19], keeping the maximum IF output level to around 500mV by adjusting the signal generator output. The AGC is switched off, and the 1st local oscillator disabled during this process by switching to an unoccupied 1st local oscillator crystal socket position instead of the VFO 1st local oscillator during this exercise.

Instead of an analogue signal generator, eg. my trusty (tube-based) Triplett 3432-A or HP8640B units, I used my GPS-disciplined HP8656B synthesized unit. The HP8656B has a minimum 10Hz resolution, but this is adequate for this purpose. This procedure identified the series resonant frequency of the crystal as 99.997KHz (photo, right). I then plotted the IF output level v. frequency in 10Hz steps, per the figure below, and interpolated the actual frequency to be 99.9971KHz (figure below). This frequency is only 29Hz lower than the crystal's nominal series resonant frequency - much closer than many 60+ year old crystals[20].



I left the HP8656B set to 99.997KHz and adjusted the primary and secondary winding slugs in the four 2nd IF transformers per instructions in the manual. Most of the slugs were already set at their peaks, with the exception of the secondary winding of 'T2' and the primary winding of 'T3', both of which were

[18] The selectivity control in this and several other Eddystone designs is mechanical, ie. it varies the coupling between the primary and secondary windings of some of the IF transformers (three of the four 2nd IF transformers in the case of the S830 series sets) – see sketch on page 3

[19] I used an HP400E AC voltmeter

[20] This is likely due to these GEC-manufactured crystal units being sealed in a vacuum in a B7G glass encapsulation rather than a simple sealed (but non-vacuum) case

found to be considerably 'off. After this, I carried out the 'rough and ready' check of the 2nd IF response symmetry per the manual (checking IF signal amplitude at frequency intervals above/below the peak), noting a slightly asymmetry was present. However, I did not try to correct this at this stage as I planned on doing that using a spectrum analyzer and tracking generator later.

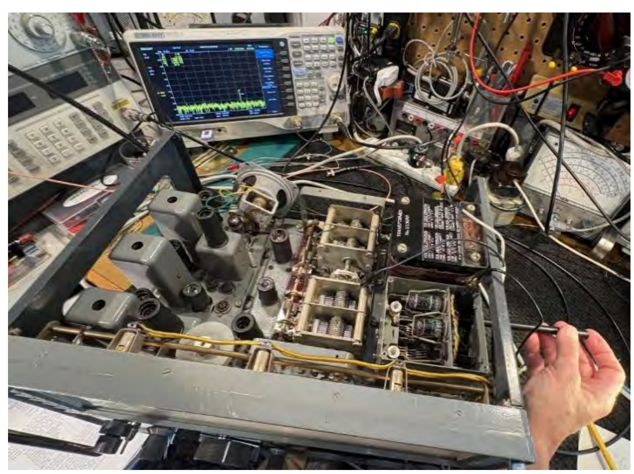
BFO Adjustment

With the 2nd IF aligned to the filter crystal series resonant peak, I then adjusted the BFO frequency on CW, USB and LSB. The first step here is to set the BFO tuning knob correctly on its pot shaft[21]. I set the BFO knob to the '3 o'clock' position when the pot was set fully clockwise, per the manual, as this is noted as providing the best symmetry of +/- frequency variation. Then, after turning the BFO knob marker to '12 o'clock', with the mode set to 'CW', the slug in the BFO/product detector coil is adjusted for zero beat. That done, I set the HP8656B to 1.5KHz above the 2nd IF frequency, the mode to 'USB', and adjusted the USB preset pot for zero beat. I then set the HP8656B to 1.5KHz below the 2nd IF frequency, the mode to 'LSB', and adjusted the LSB preset pot for zero beat. Finally, I checked that the BFO could be adjusted approx. +/-100Hz on both the 'USB' and 'LSB' positions: it could, and with approx. +/-3kHz on the 'CW' position.

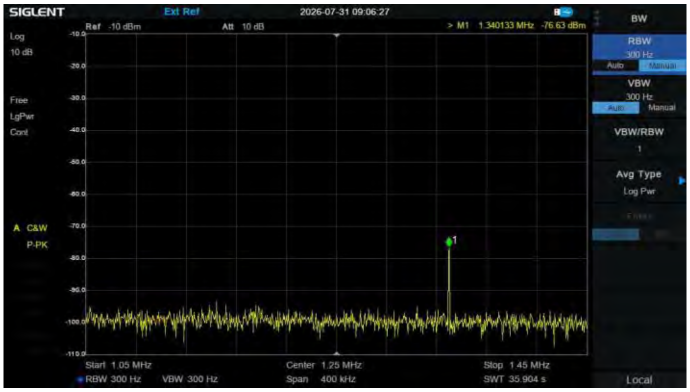
2nd Local Oscillator/2nd Mixer/Tunable 1st IF Alignment

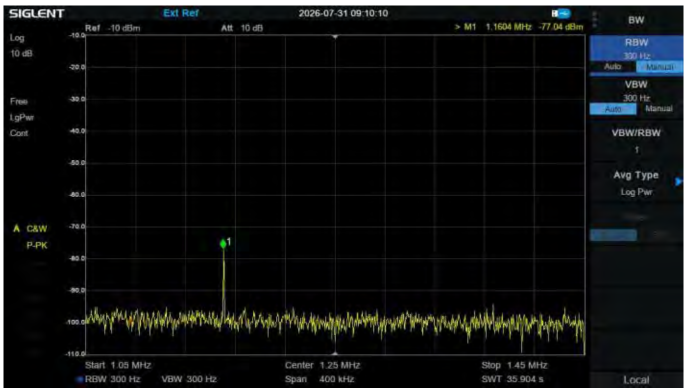
With the 2nd IF/BFO alignment complete, I moved on to the 2nd local oscillator/2nd mixer/tunable 1st IF alignment. The 1st IF, nominally at 1350kHz, is tunable +/-100KHz from this frequency by the 'Incremental Tuning' control, to provide a tuning frequency resolution of <1KHz on the bands where dual-conversion is used (above 1.5MHz, ie. Bands 1 through 6). The alignment procedure described in the manual uses 100KHz and 10KHz crystal marker oscillators to undertake this. Of course, this is somewhat obsolete when accurate synthesized signal generators and spectrum analyzers are available. The 1st local oscillator tracks on the low side of the 2nd IF, operating in the range 1150KHz to 1350KHz range to produce the 2nd IF frequency of 100KHz across the incremental tuning range.

An initial check of the 2nd local oscillator tracking found that the alignment was significantly 'off' (>20kHz). I initially made a very quick re-adjustment of the coil and trimmer on the 2nd local oscillator to correct the worst of this, though the tracking was still not good (should be within 1KHz across the 200KHz span). I did this rough alignment using the HP 8656B signal generator tuned to either end of the incremental tuning dial span and adjusting the relevant slug and trimmer (L36/C65) with a couple of iterations. I then decided to use a spectrum analyzer (Siglent SAA-3021X) to bring the 2nd local oscillator into better alignment, using the tracking points noted in the manual, ie. 10KHz in from either end of the incremental tuning range ('90' on the red section of the scale and '90' on the black section of the scale), representing local oscillator frequencies of 1160KHz at '90' on the red section of the scale, and 1340KHz at '90' on the black section of the scale (photo, right). I



[21] The BFO is tuned by a varicap diode in this and some other 830 series variants, and by a small variable capacitor in some other variants





placed a small e-field probe coupled to the spectrum analyzer into the 2nd local oscillator/tunable 1st IF compartment (with the top cover removed), and set about adjusting the slug and trimmer to obtain good tracking. I recalled from previous experience doing this on other S830 sets that when the tuned circuits are significantly out of adjustment, this takes a lot of iterations – true to form, it took me around an hour until I was satisfied with the result (the spectrum analyzer plots, left, show the 2nd local oscillator output signal when tuned to the upper and lower calibration points, ie. 1340KHz and 1160kHz respectively. After that, I replaced the top cover onto the compartment and inserted the e-field probe into the L35 access hole on the side cover. The tuning was now a little 'off' due to the top cover now being in place, but a couple more of iterations of the slug and trimmer took care of that. I then confirmed this alignment using the HP8656B signal generator connected to the grid of the 1st mixer tube and checking the tunable 2nd IF tracking at spot frequencies across the 200KHz incremental tuning span - all ok.

Next, I removed the top cover again, this time to allow access to the two trimmers (C74/C77) for the tunable 1st IF transformer – photo, right. The two corresponding slugs (L34/L35) are accessed through holes on the side cover[22]. I managed to adjust the slugs/trimmers ok (not stuck slugs as in the S830/2 I worked on previously thank goodness!), and only around six iterations were needed to obtain good tracking and level output across the 200KHz incremental tuning span (1250KHz to 1450kHz).

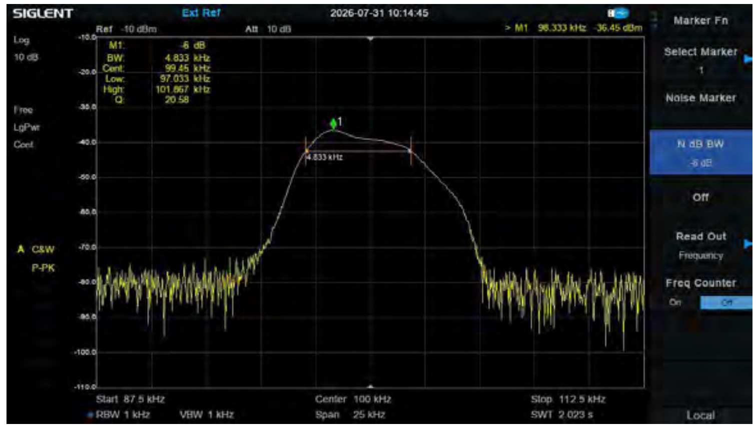
Checking/Adjusting the 2nd IF Response Curves

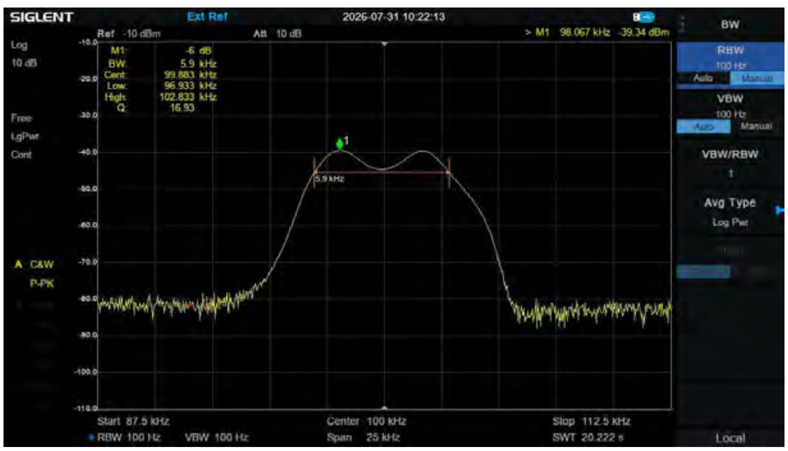
With the 2nd local oscillator/tunable 1st IF now aligned, I decided to check the 2nd IF (100KHz) response (selectivity) curves with the Siglent spectrum analyzer/tracking generator. This can be done on an S830 model by switching to one of the single conversion bands, ie. Bands 7 - 9, and injecting the swept

[22] Why Eddystone did not provide access holes for the two trimmers in the top cover is a bit of a mystery: if they were concerned with dust entering through them, they could have installed movable covers over them

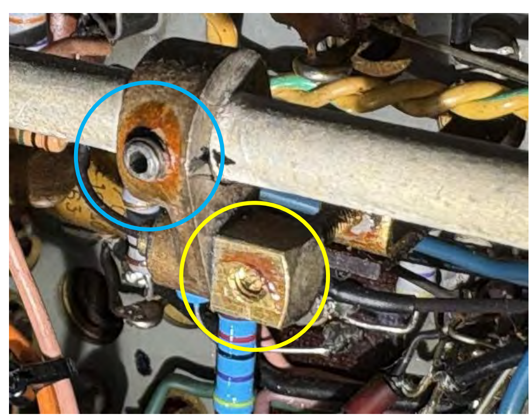
100KHz signal from the tracking generator into the grid of the 1st mixer tube. The output to the spectrum analyzer was taken from the junction of the final 100KHz IF transformer (T4) and the 500pF IF filter capacitor (C104) via a x10 'scope probe and DC block.

I found that on the widest selectivity positions (AM and SSB) there was some asymmetry of the response curves (AM response curve shown right), as I had anticipated from the crude checks on the response symmetry undertaken previously by detuning the signal generator above/below the 2nd IF centre frequency. I corrected this by slight adjustments of the slug in the second IF transformer (T2), and the slug in the secondary winding of the first IF transformer (T1). However, the resulting curves, although more symmetrical, look somewhat over-coupled, with two distinct 'humps' forming the peak of the curve, these having an amplitude of almost 6dB in the AM position, instead of a flatter or curved peak(AM response curve shown left). Also, the 6dB bandwidths on the non-crystal settings of the selectivity control, except in the 'AM' position, were all wider than spec., these being 5.90KHz on 'AM', 4.57KHz on 'SSB', and 2.37KHz on 'CW'[23]. The narrowest selectivity position (crystal in circuit, position 'N') had a bandwidth of 108Hz, with very steep skirts. The Appendix includes several more IF response curve plots.





Further re-adjustment of the slugs in the 2nd IF transformers would not correct this, as I suspected that someone had tweaked one or more of the screw adjustments from the eccentric collars (cams) on the selectivity control shaft to the actuating rods that move the 2nd IF transformer primary windings closer to or further away from the secondary windings (more and less coupling respectively) – see the IF transformer sketch on page 3.



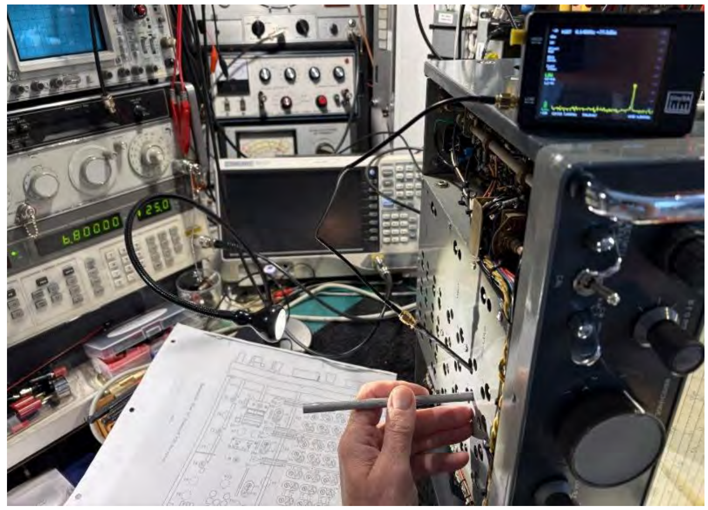
Inspecting the three actuating rod adjustment screws (present on T1, T3 and T4), it appeared that the screw on the rod for T3 (circled yellow in photo, right) had been screwed inwards much more than on T1 or T4, and the

[23] The -6db IF bandwidth spec.'s are 6KHz (AM), 3KHz (SSB), 1.3KHz (CW) and 50Hz (N)

varnish used to seal the locking nut on this screw had been disturbed. I therefore considered that this was likely to be the reason for the over-coupling observed on the response curves. I loosened the locking nut and then tried to turn the (brass) screw, but it was jammed tight, and I risked gnarling the screw head. As the eccentric collars can be rotated a little on the control shaft by undoing their set screws (circled blue on the photo at the bottom of page 27), I decided to try this instead, but after I had completed the initial RF alignment.

Initial RF Alignment

The initial RF alignment went fairly smoothly, though many slugs and trimmers were significantly 'off', especially the RF stage and 1st mixer stage on Bands 3, 4 and 5, though some of the 1st local oscillator slugs and trimmers also needed some adjustment to achieve good tracking at the alignment frequencies at either end of the scale. The photo, right, shows the 1st local oscillator slug being adjusted at the lower end of Band 3 using an HP8656B signal generator and a TinySA as a double-check on the 1st local oscillator output signal.



Thankfully, none of the slugs or trimmers were stuck, however, I decided to re-visit a few of the slugs and add a small touch of ROCOL Kilopoise thixotropic grease to their threads, as I noticed that they were a little on the loose side in their formers - this was to mitigate unwanted movement due to vibration.

2nd IF Response Curves Revisited

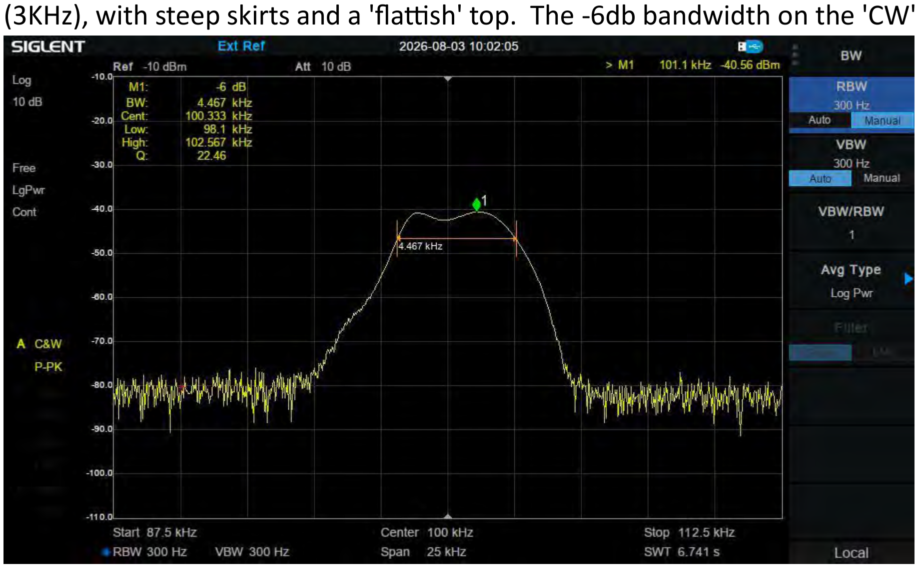
As noted above, I tried rotating the eccentric collars slightly with respect to the selectivity control shaft, however, although this helped, I still could not obtain satisfactory response curves. I concluded that the screw adjuster on the T3 IF transformer primary needed to be re-set to a similar position to the screw adjusters on T1 and T4. The screw adjuster on T3 had been tampered with by someone, as the varnish used to seal the screw and its locking nut in position (at the factory) had been disturbed, and the screw head was screwed as far into the threaded bushing as it would go (increasing the coupling in that IF transformer).

I had tried to turn this small slotted brass screw previously, but it was stuck tight - possibly due to remnants of the varnish that had been applied to it at the factory. So, this time, after I slackened-off the locking nut again, I used some acetone applied with Q-Tips to dissolve the varnish around the screw head. After some gentle coaxing and applying some thin oil to the threads, the screw finally turned, and I was then able to set the top of the screw to approximately the same position as those in T1 and T4 (photo, left). This improved the response curves significantly, and with some further minor adjustment of all three eccentric collars. ie. rotating with respect to the selectivity control shaft, I was able to obtain much better (narrower) bandwidths on all three non-crystal selectivity settings of the control, as well as much-reduced 'humps' on the 'AM' selectivity setting.

These mechanical adjustments - both the screw adjusters and the eccentric collars - are not addressed in the S830/4 manual, and I have not had to do this on any other Eddystone set I have ever worked on with mechanical selectivity controls over the past 20+years. It was therefore an interesting exercise to see how these adjustments, normally set once at the factory, affected the IF responses.

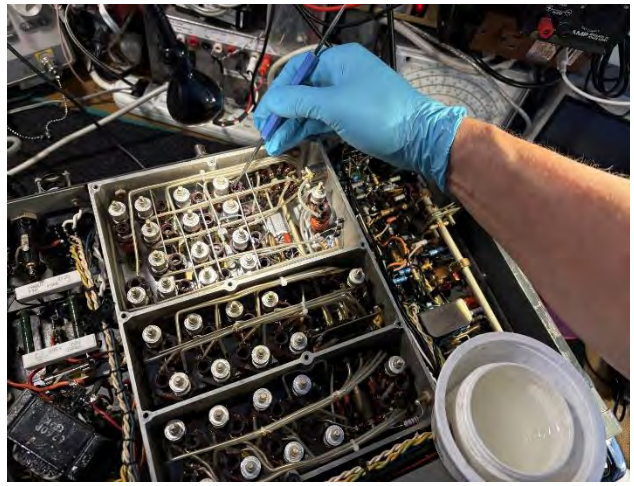
I found that the setting of the eccentric collar adjustment on T1 was critical, as the rod linking the eccentric collar to the transformer primary also operates the microswitch that opens its contacts in the 'N' (crystal in circuit) selectivity position, and if set too far towards the less-coupled end of its travel, the crystal is placed in circuit too soon, ie. at the 'CW' selectivity setting. The location of the microswitch relative to the actuating rod can be altered to adjust this setting, however, the screws/nuts to loosen the microswitch face the side of the chassis/coilbox and are therefore not accessible unless significant disassembly is undertaken (or incorrect tools are used, with possible resultant damage) – photo, right.

With the mechanical adjustments optimized for selectivity, the shape of the response curves were now slightly asymmetrical, so some iterative adjustments of the slugs in T1 (secondary winding) and T2 2nd IF transformers were needed. With this done, I was now satisfied with the resultant response curves: on the 'AM' selectivity setting, the -6dB bandwidth was around 5KHz (a little wider if the center point of the passband is used as the reference point and not one of the 'peaks') and the depth of the 'valley' (trough) to the twin 'peaks' (crests) on the curve was now only around 2dB, which is certainly acceptable (see plot below). This bandwidth is a little narrower than spec. (6KHz), but still good for general AM listening on the shortwave bands (the S830/4 variant does not cover most of the Broadcast band). The 'SSB' selectivity setting -6db bandwidth was now around 2.7KHz, which is very slightly narrower than spec. (3KHz), with steep skirts and a 'flattish' top. The -6db bandwidth on the 'CW' selectivity setting was now around 1.6KHz, with very steep skirts and a rounded top (spec. is 1.3KHz), and the crystal filter -6dB bandwidth ('N' setting of the selectivity control) was now 43Hz (spec. is 50Hz), with exceptionally steep skirts - giving real 'single signal' reception for CW. The Appendix includes IF response plots for all selectivity positions.



Final RF Alignment

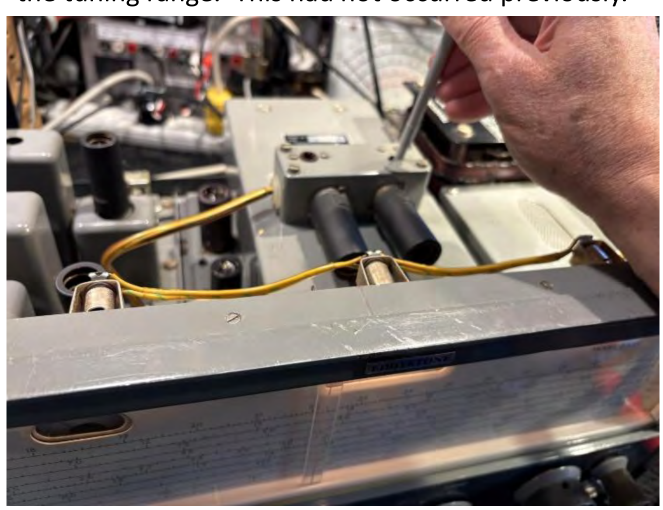
I removed the RF coilbox cover and added a dab of ROCOL Kilopoise high viscosity thixotropic grease to the threads in each of the RF transformers (photo, right), this would be smeared onto the slugs when I undertook the final RF alignment, mitigating unwanted movement of the slugs. With the coilbox cover removed, I took the opportunity to re-clean some contacts on the band switch with Deoxit D5, as this switch had now seen quite a bit of use since its first cleaning, which can result in some remnant tarnish being loosened on the contacts - this second cleaning would hopefully increase the switch's long-term reliability.



I re-installed the coilbox cover and checked the receiver operation - all was working ok. Then, on each band at the low frequency alignment setting, I detuned all the relevant slugs by unscrewing it a few turns so it coated the slug threads in the ROCOL grease, then screwed the slugs back into place to peak the response, then tweaking the trimmers at the high frequency alignment setting. Some iterations of slug/trimmer adjustments were needed on some bands to optimize tracking and sensitivity.

Next, I adjusted the 100KHz IF trap when the receiver was tuned to 125KHz on Band 9 (photo, left), and tweaked the crystal calibrator to exactly 100KHz against the (GPS-disciplined) HP8656B – photo, below).

During this final alignment, I occasionally heard a few crackles while tuning through the central section of the tuning range. This had not occurred previously.



With the alignment completed, I removed the tuning gang cover and carefully inspected the rotor and stator vanes in each section of the tuning gang. I also inserted a thin piece of plastic between each set of a vanes - this identified the problem was a slightly inwards-bent segment on the outermost rotor vane of the local oscillator section of the gang which was making intermittent contact with the adjacent stator vane. A very slight tweak of the rotor vane segment outwards cured the issue. After re-installing the tuning gang cover, I checked the tracking on all bands and it was not affected.

Performance Tests

After completing the alignment, I checked the sensitivity and signal to noise ratio at approx. mid-frequency on each band (this is likely the 'worst case' position as the alignment is optimized towards the band edges). I initially used the HP8656B for the minimum discernable signal tests[24], though I found that this signal generator could not provide a weak enough signal for this check with the S830/4 on 'CW' mode[25] as it was below the lowest signal level from the HP8656B, ie. 0.1uV, so I repeated these tests using an HP8640B (photo, top right) to identify the actual lowest discernable CW signal on all bands.

The signal to noise ratio was measured using an Agilent 8935 test set (photo, bottom right)- the receiver met or exceeded its signal to noise spec. (>15dB for 3uV) on all bands except Band 5, where it was marginally under spec. (~14dB

No attempt was made at matching the 50ohms output impedance to the (nominal) 75ohms input impedance of the receiver, other than alignment of the antenna tuned circuits with this mismatch included (often quoted as 0.18dB loss). The minimum discernable signal level and SNR measurements were recorded as follows:

		HP8656B		**HP8640B**		**Agilent 8935**
Band	**Frequency**	**AM**	**CW**	**AM**	**CW**	**AM SNR**
1	24.0MHz	>0.15uV	>0.1uV	>0.2uV	>0.02uV	18.62dB
2	14.5MHz	>0.25uV	>0.1uV	>0.25u	>0.025uV	17.94dB
3	9.0MHz	>0.25uV	>0.1uV	>0.25uV	>0.02uV	15.17dB
4	5.5MHz	>0.2uV	>0.1uV	>0.2uV	>0.03uV	18.44dB
5	3.3MHz	>0.25uV	>0.1uV	>0.25uV	>0.025uV	13.57dB
6	2.0MHz	>0.3uV	>0.1uV	>0.25uV	>0.025uV	16.92dB
7	450KHz	>0.3uV	>0.1uV	>0.3uV	>0.02uV	23.53dB
8	270kHz	>0.3uV	>0.1uV	N/A	N/A	22.14dB
9	160KHz	>0.25uV	>0.1uV	N/A	N/A	22.05dB

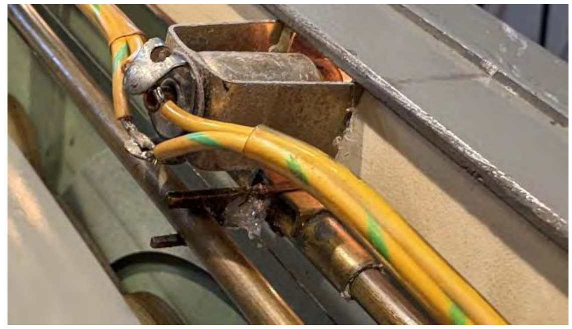
[24] The signal strength figures for the HP8656B and HP8640B are 'minimum discernable signal' levels - this is usually quoted as being 3dB above the noise level, however, the figures here are what my ageing ears could just pick up above the noise(!)

[25] The HP8640B has much lower phase noise than the HP8656B, and can attenuate signals down to around 0.015uV, but cannot output frequencies below 425KHz

These are very respectable results for a 60+ year old tube receiver, so should provide good results on the air with a reasonable antenna[26].

Some De-modding, Final Inspection and Checks

With that done, I gave the chassis a final visual inspection, including a slight re-dressing of the dial light wiring to avoid any possible fouling of the tuning mechanism or shorts[27] (photo, right), and placed the chassis back into its case (I had already vacuumed and wiped the case down, inside and out). The owner plans to have the case re-sprayed, so no attempt was made to touch-up any of the paintwork, which is badly scratched and scuffed in parts.



The set's owner had asked me to remove the internal speaker (added, rather crudely using one bolt, by a former owner – photo, left). I did this and noted that the output transformer was a replacement (the original would have been shrouded). Some wiring changes that had been done to accommodate the internal speaker were also reversed so that the external speaker would be cut off when the 'phones jack was inserted on the front panel (as it should). I also disconnected the muting circuit shorting link that had been wired behind the output Jones socket, and added a link into the mating Jones plug to do this instead. The audio quality was much better using a good external speaker.

The set was then placed back on soak test, monitoring the internal temperature (photo, right). I left it switched on as background entertainment when I was in the 'shop over the next couple of days to make sure all was well prior to packaging it up ready to ship back to its owner.

Closure

After this almost complete electronic re-build project on a rather 'rough' example of this

[26] I only tuned in to WWV on 5, 10 and 15MHz on the shortwave bands and local stations on the upper end of the Broadcast band (above 1.5MHz) using a small active indoor magloop antenna as there is strong interference (man-made RF noise) on many frequencies at my location

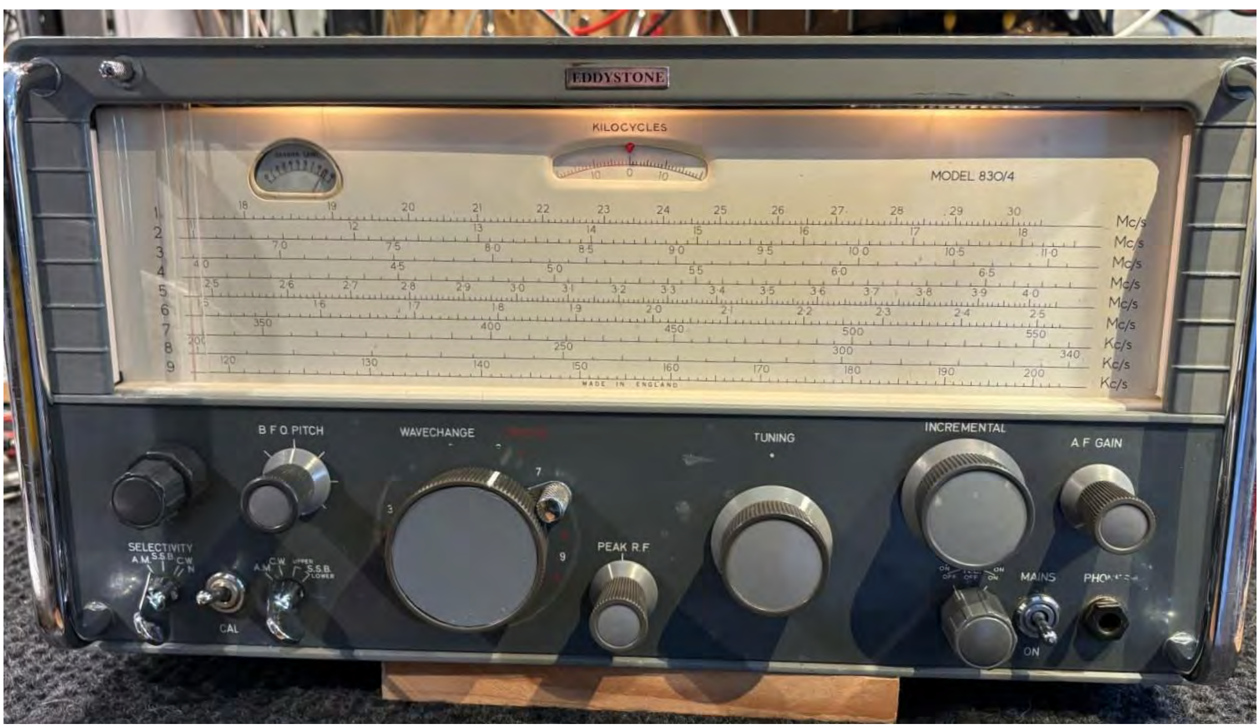
[27] Shorting dial bulb holders is a well-known 'Achilles heel' of Eddystone tube radios – often causing melted insulation on the dial bulb/tube heater wiring

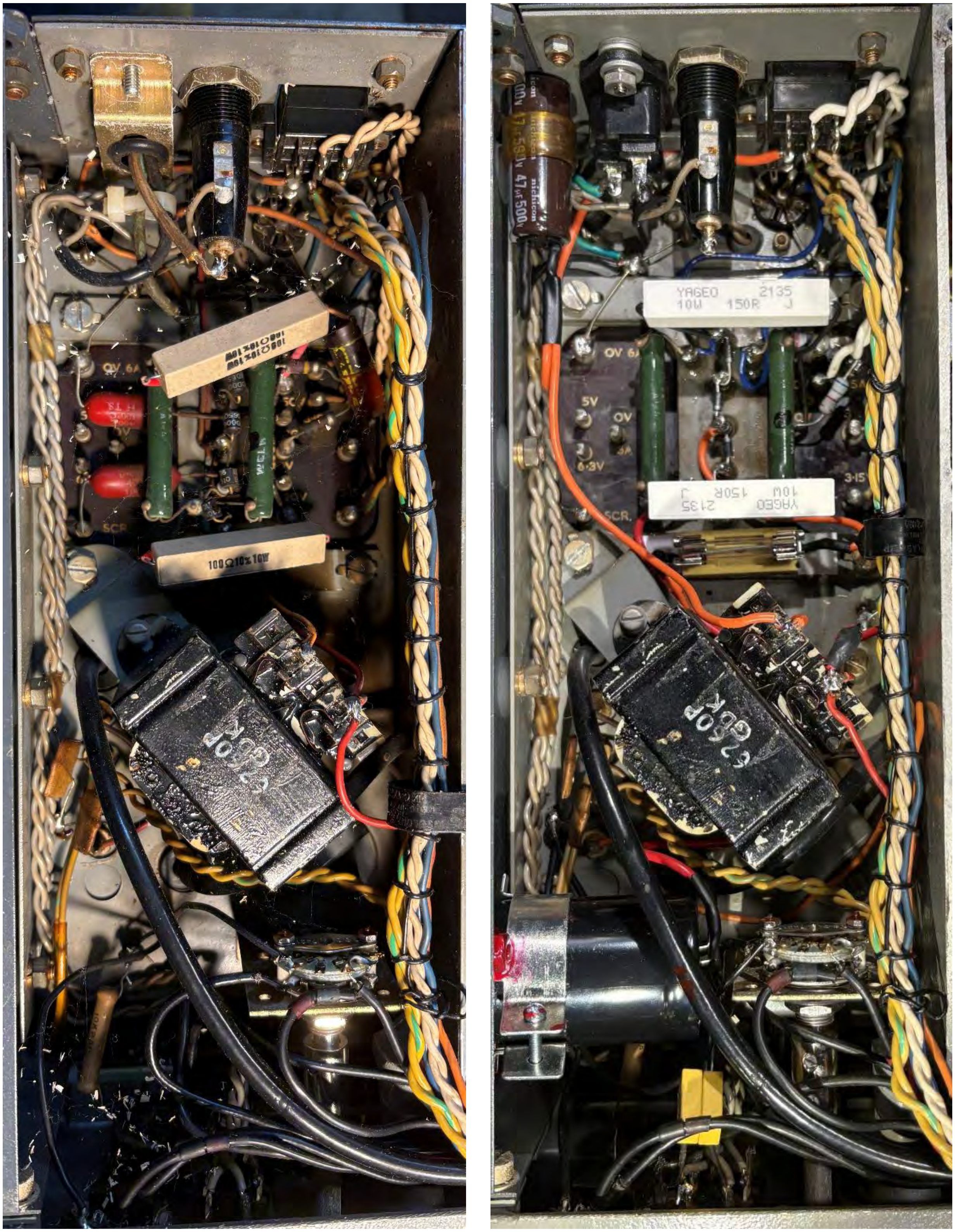
model ('as found'), I consider this set is now performing much as it did when it left the 'Bathtub' around 60 years ago (maybe better!). The only tell-tale signs of its age, apart from the cosmetics, which will be much-improved after the re-spray and, hopefully/eventually NOS knobs and a repro fingerplate, are that the main tuning action has a (very slight) bearing 'rumble' when its spun fast, and the band change switch very occasionally needs a little 'coaxing' on a couple of the bands (rocked slightly to ensure good contact) - not too bad for a 60-year old...

In case anyone was wondering how many parts were replaced in the set (bagged-up in the photo, right), I counted a total of 96 resistors (including two 10W power resistors), 20 tubular paper capacitors (4 replaced with silver mica types), 1 tantalum capacitor (should have been an electrolytic - in the 1st audio stage), 5 tubular electrolytics, 1 dual (can) electrolytic, 2 silver mica capacitors, 4 plastic film capacitors, 4 rectifier diodes, the line cord socket/line cord, two (black anodized) tube shields, and numerous screws, nuts and washers.

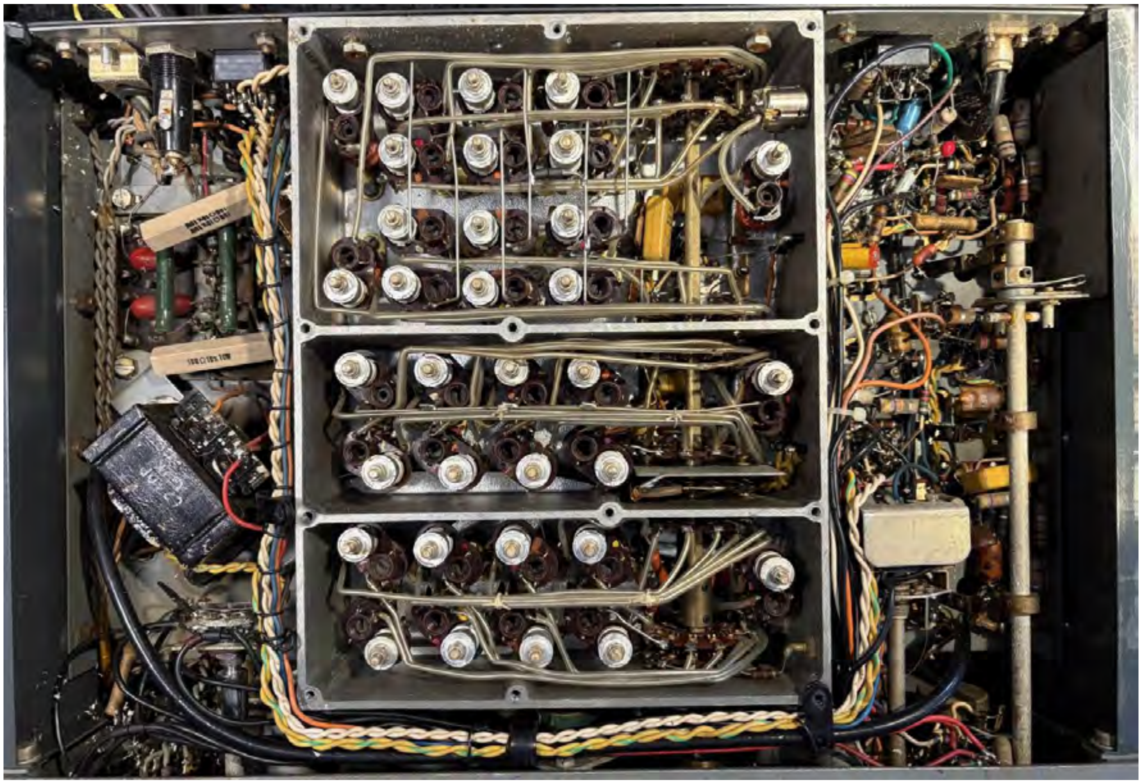
Above: front panel of the S830/4 prior to commencing refurbishment work – note the damaged knobs and the non-Eddystone knob on the AGC/Noise limiter control

Below: front panel of the S830/4 after undertaking the refurbishment work – the damaged knobs have been repaired and the AGC/Noise Limiter knob has been replaced with an Eddystone knob (from an EC10 receiver)

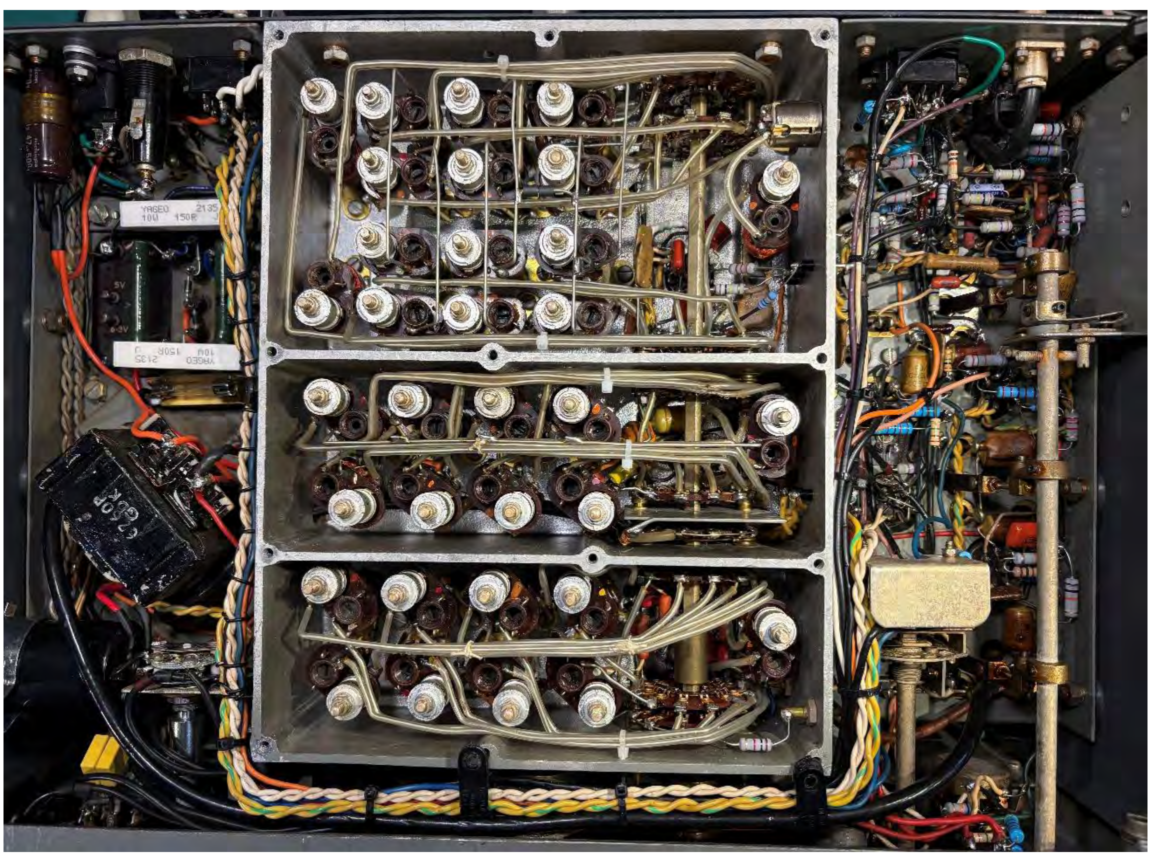


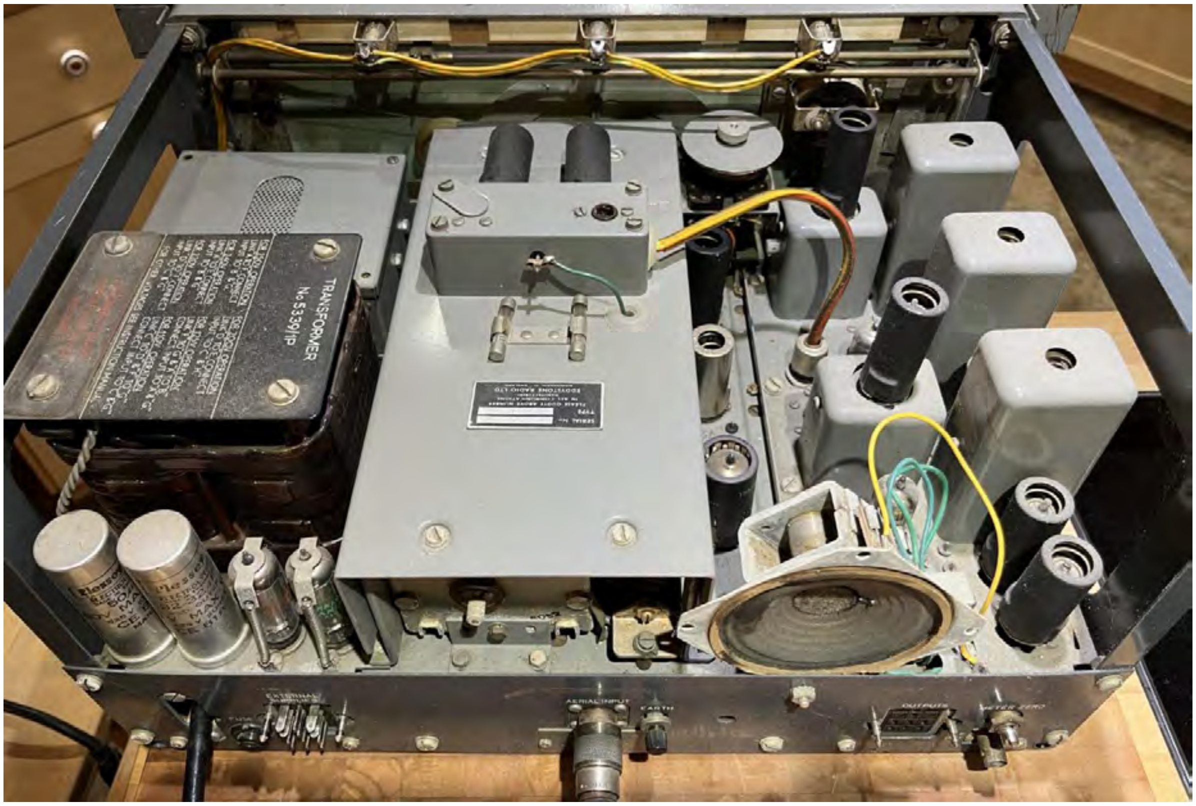


Above left: the power supply compartment before refurbishment. Above right: the power supply compartment after refurbishment

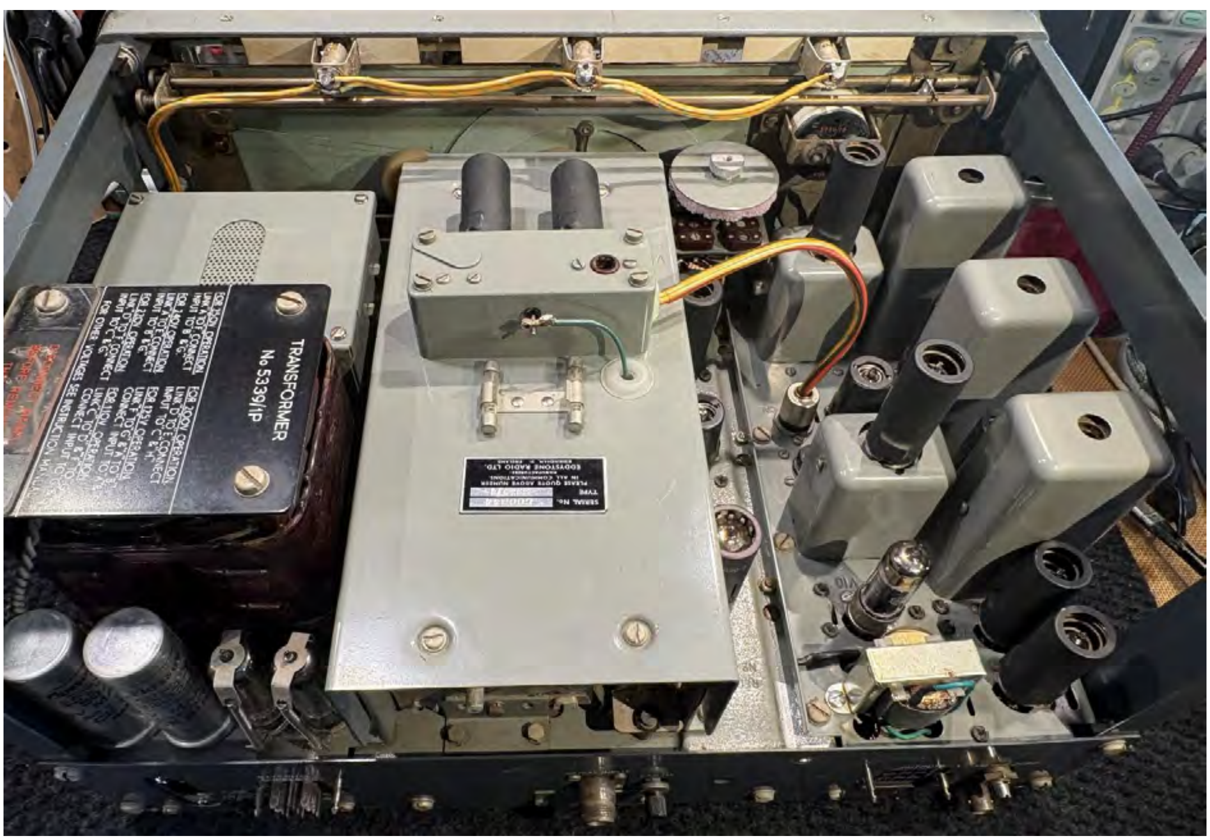


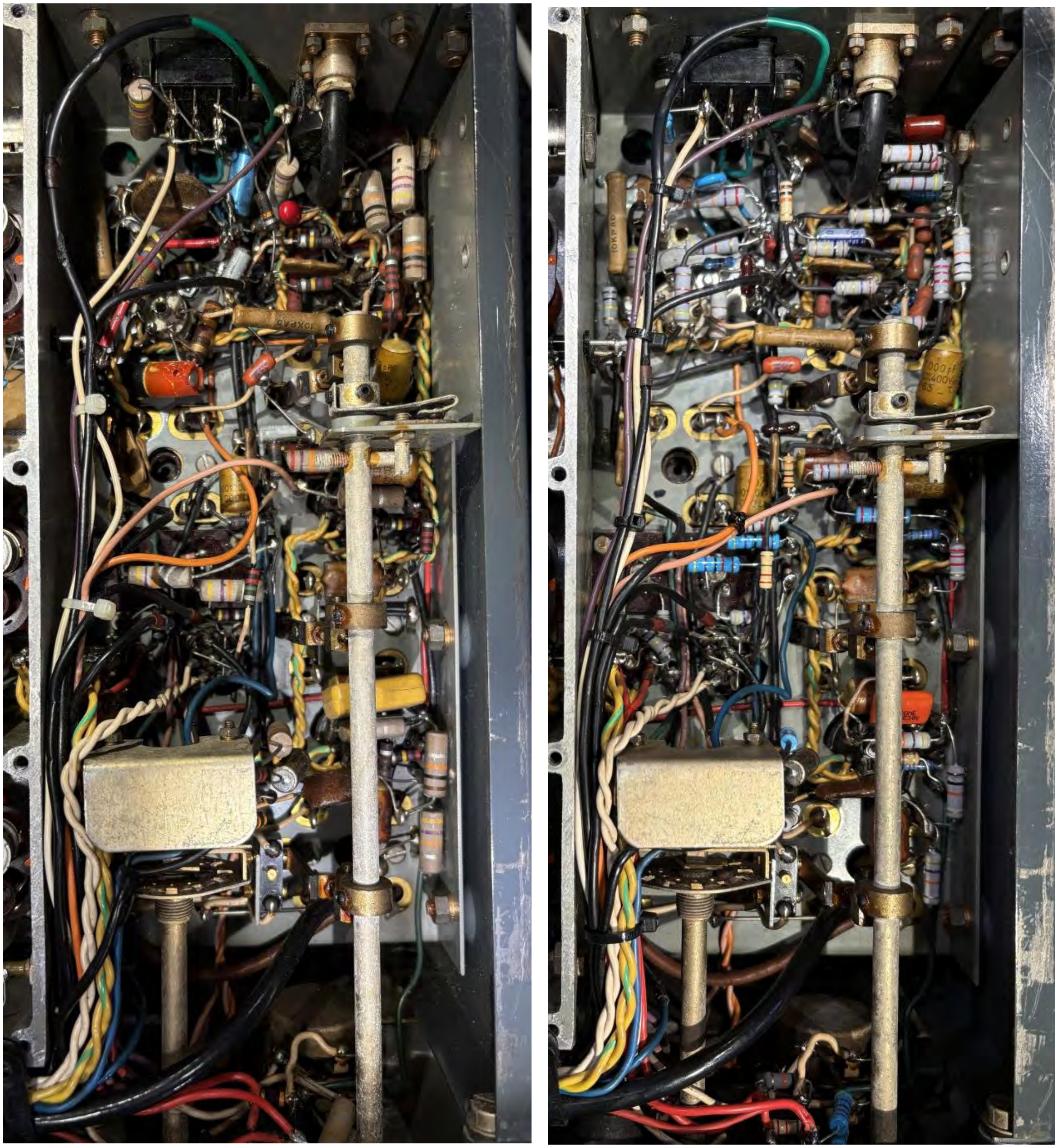
Above: underside of the chassis before refurbishment. Below: underside of the chassis after refurbishment (both with the coilbox cover removed)



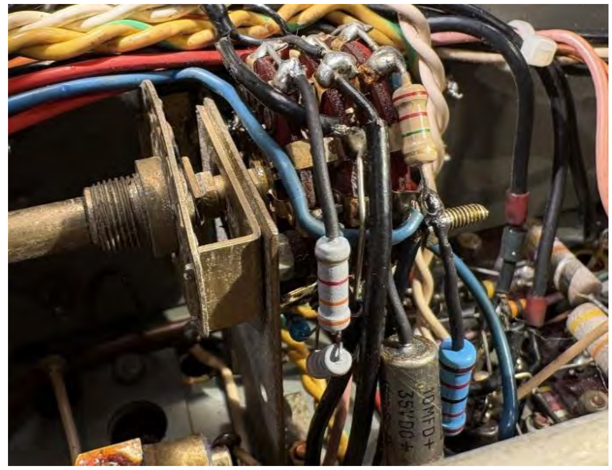


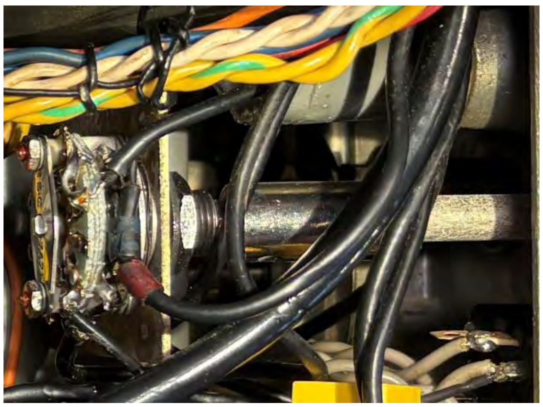
Above: upper side of the chassis before refurbishment. Below: upper side of the chassis after refurbishment



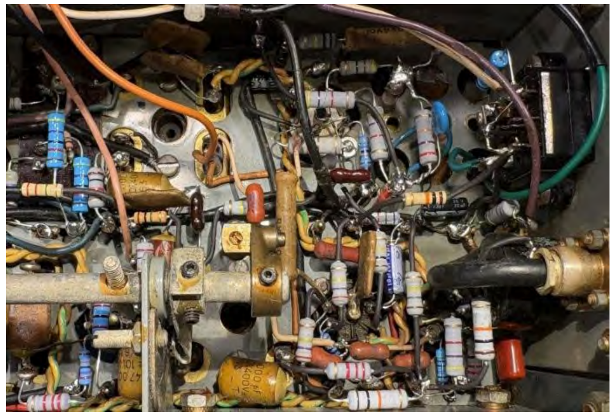


Above left: the 2nd IF, BFO/product detector/AM detector, noise limiter, AGC and audio stages before refurbishment. Above right: the 2nd IF, BFO/product detector/AM detector, noise limiter, AGC and audio stages after refurbishment. All resistors have been replaced in these parts of the circuit, along with paper dielectric and electrolytic capacitors

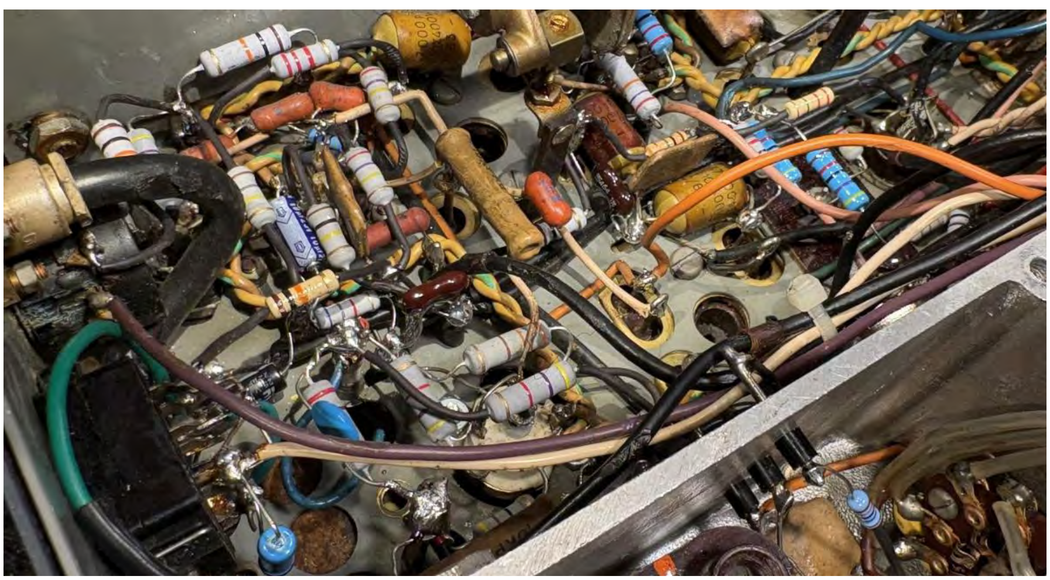




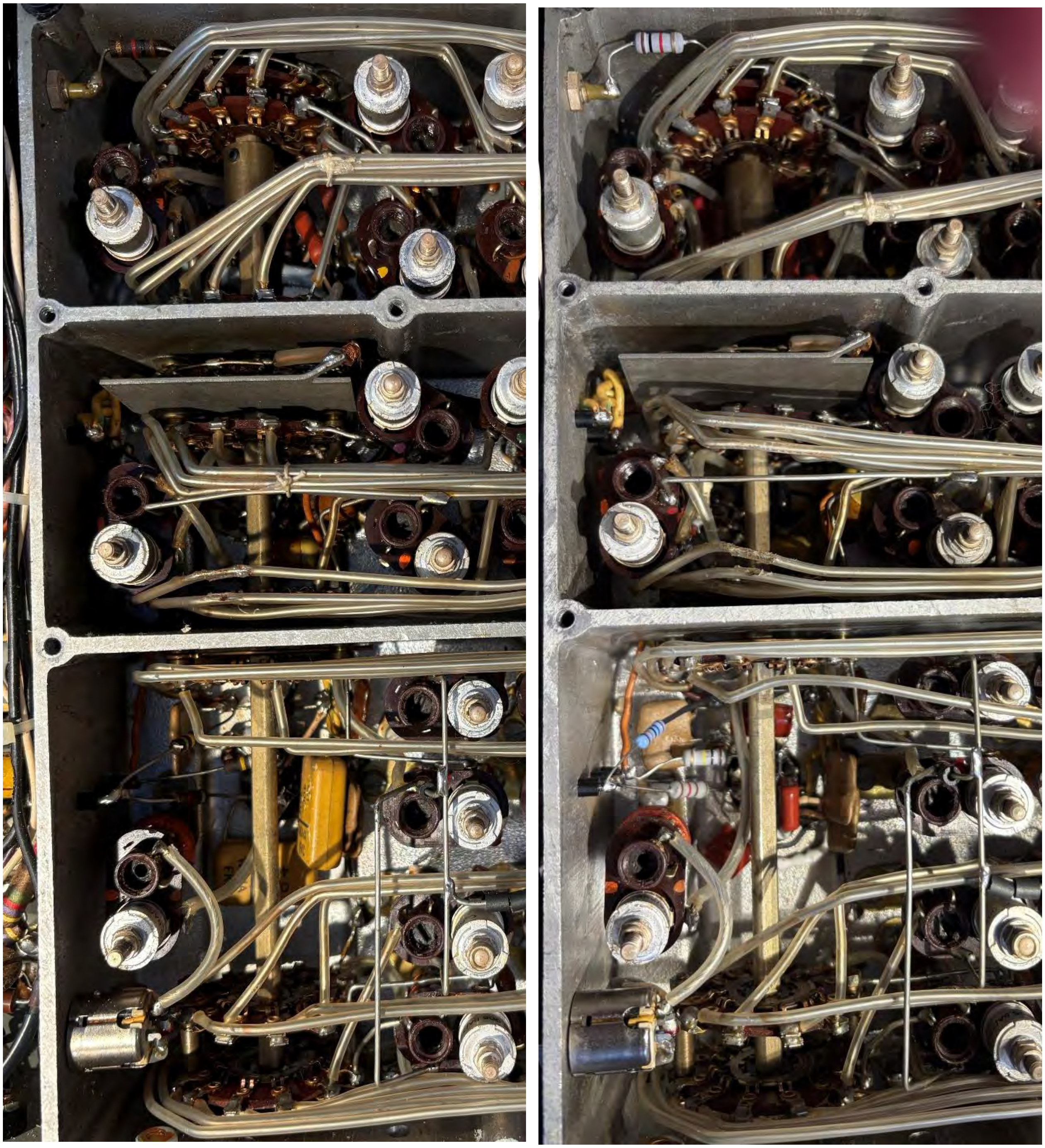
Above left/right: close-up of the components on the 'mode' (AM/CW/USB/LSB) switch – only the metal clad tantalum capacitor is original (tested very good). Left: the AGC/NL had been replaced by someone in the past (this is working ok). Below left: the 100KHz 2nd IF filter crystal. Bottom left: measuring the leakage current on a Dubilier 0.01uF capacitor at 160uA(!). Below top: fishpaper installed in the 'External Supplies' Jones plug. Below bottom: measuring the capacitance value of a Dubilier 0.01uF capacitor at 138pF(!)

Above: the BFO/AM detector/noise limiter/1st audio and audio output section of the chassis (left – before refurbishment, right – after refurbishment). Below: close-ups of the same

Left: oblique photo of the refurbished BFO/AM detector/noise limiter/1st audio and audio output section of the chassis, showing the layered construction technique used



Above left: the RF amplifier, 1st mixer and 1st local oscillator stages before refurbishment. Above right: the RF amplifier, 1st mixer and 1st local oscillator stages after refurbishment. All resistors have been replaced in these parts of the circuit, along with paper dielectric capacitors and two silver mica capacitors (one of the originals was damaged during the refurbishment work, the other by contact with the band change switch shaft due to poor component dress)

Above: underside of the chassis after refurbishment (with coilbox cover installed).
Below: the refurbished set on soak test – performing well!

Bibliography

The Eddystone User Group published a Newsletter from 1990 through to 2006 (titled 'Lighthouse' in later years). This magazine is a valuable source of information and tips on most Eddystone models, including the S830 series. All of the issues are available online, as well as an index by model and topic. Below are a few references to the S830/4 variant, and one for the S830/7 variant that includes an extended technical article on servicing this receiver. Issue 77 of 'Lighthouse' was an '830 Special'.

S840/4

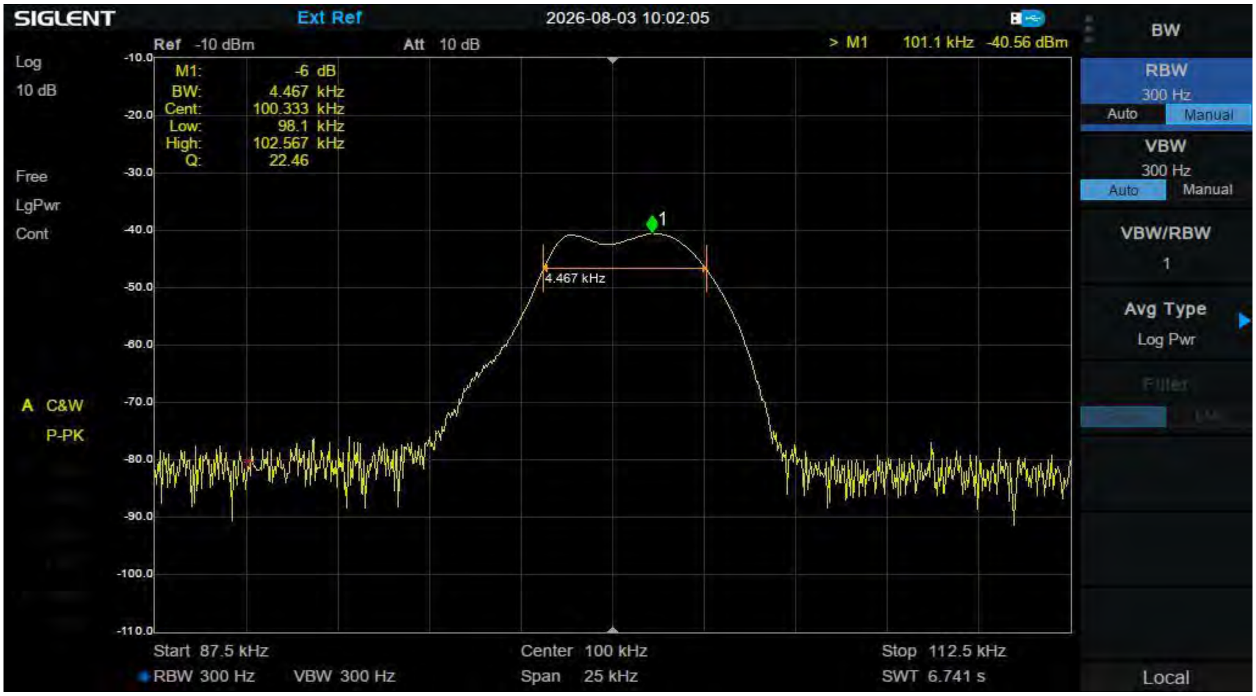
S830/7

Appendix

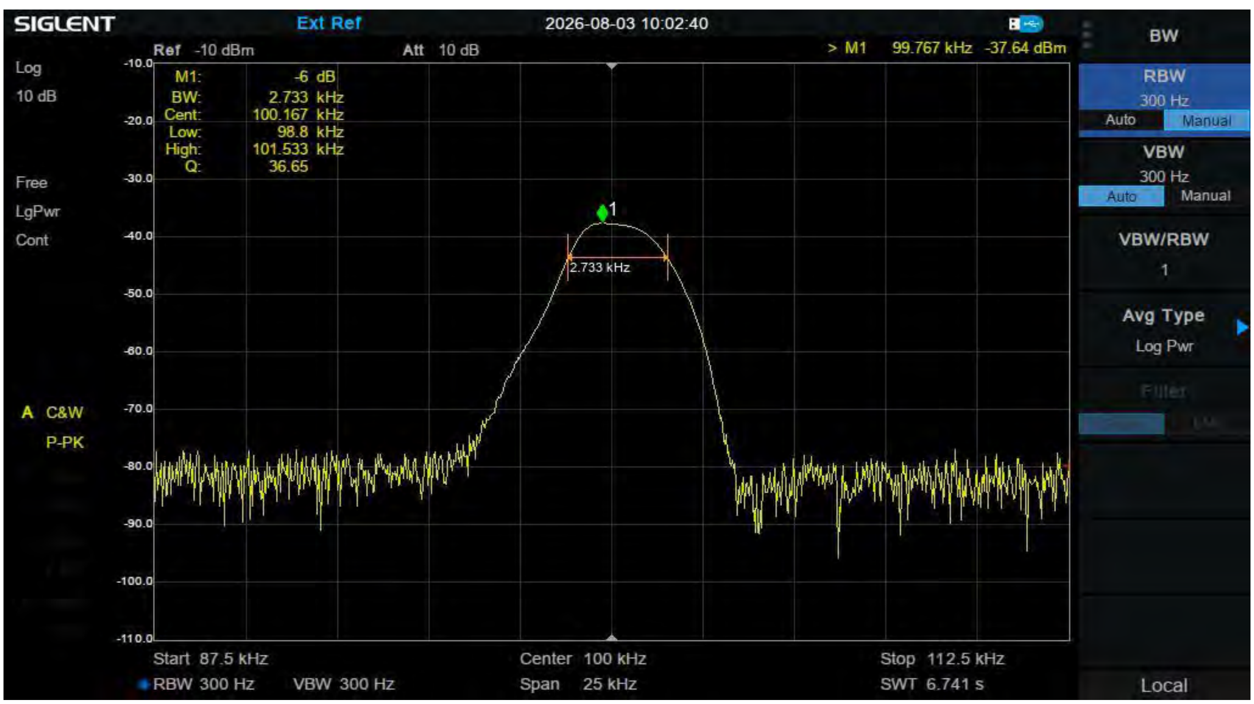
- 2nd IF Response Curves
- Signal to Noise Measurments
- Thermal Images
- Chassis Layout Diagrams
- Schematic

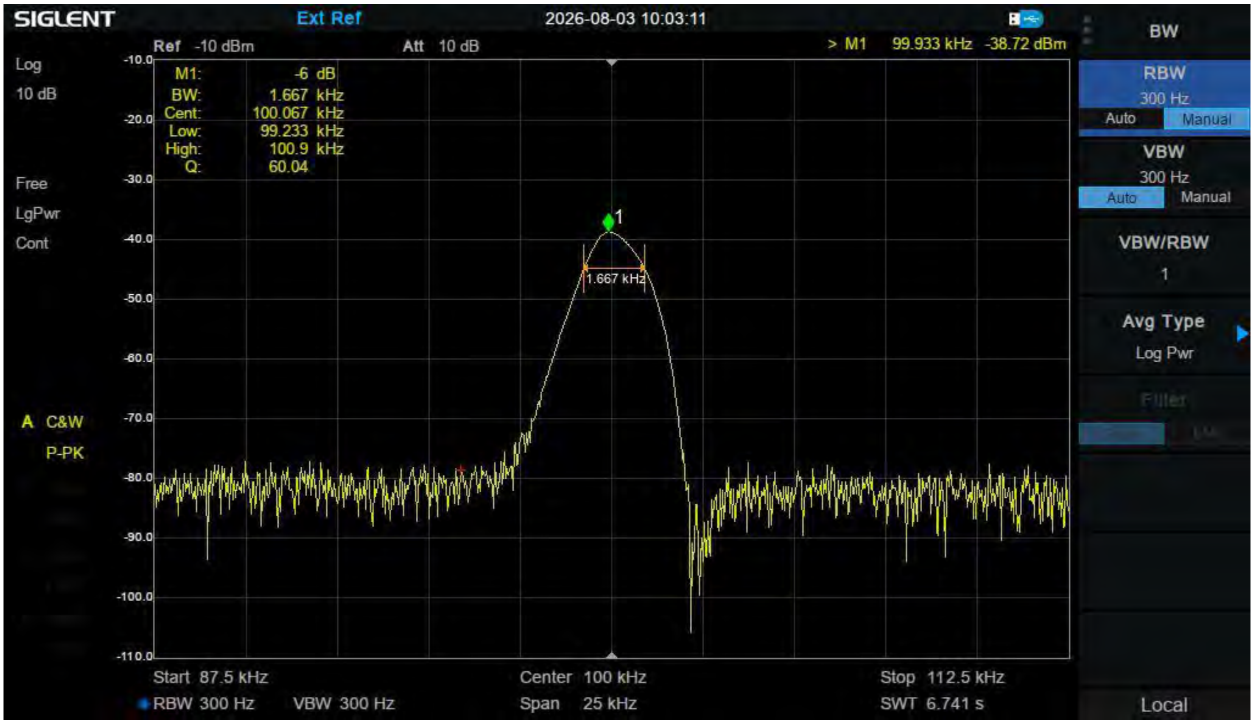
IF Response Curves

The 2nd IF response curves shown below were obtained using a Siglent spectrum analyzer (with tracking generator), with the receiver on Band 9, non-VFO 1st local oscillator (effectively defeated as no 1st local oscillator crystals installed), tracking signal to 1st mixer tube grid, spectrum analyzer to AM detector.

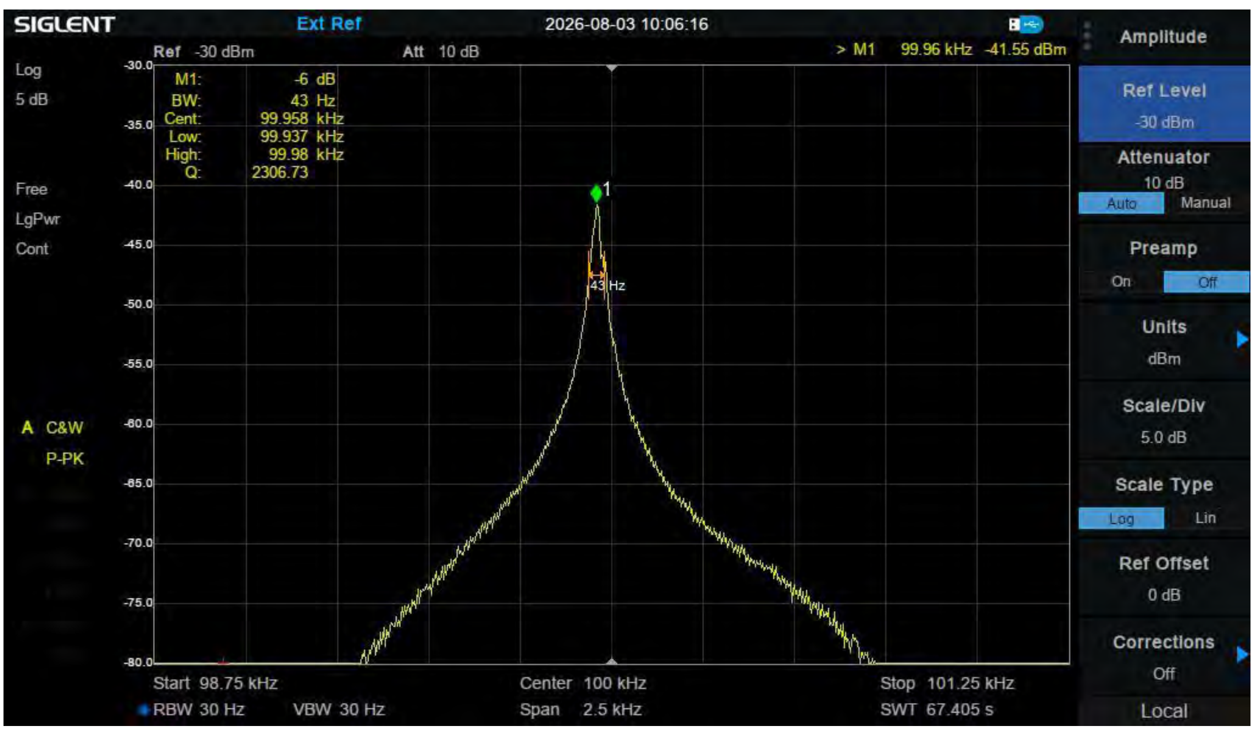


Above: 100KHz IF response on 'AM' setting of the Selectivity control (bandwidth = 4.467KHz @ -6dB) – a slightly wider bandwidth (>5KHz) was obtained when the reference point was the 'dip' in the top of the curve rather than one of the 'peaks' as shown here. Below: 100KHz IF response on 'SSB' setting of the Selectivity control (bandwidth = 2.733KHz @ -6dB)



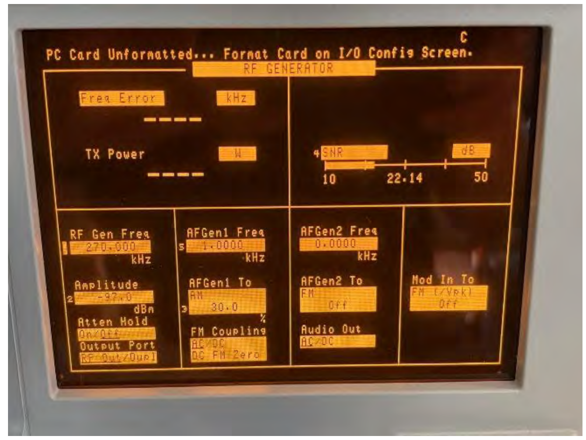


Above: 100KHz IF response on 'CW' setting of the Selectivity control (bandwidth = 1.667KHz @ -6dB). Below: 100KHz IF response on 'N' (crystal) setting of the Selectivity control (bandwidth = 43Hz @ -6dB).

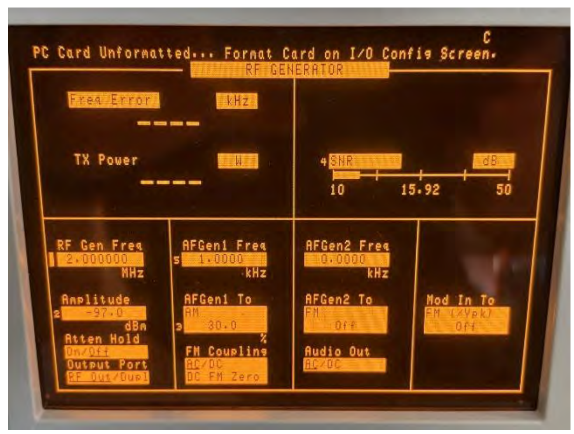


Signal to Noise Ratio (SNR) Measurements

An Agilent 8935 (E6380A) CDMA test set was used to measure the signal to noise ratio of the receiver at a frequency near the centre of each band, as shown on the following screenshots. The S830/4 manual notes "*With an IF bandwidth of 3kc/s* [approximating to 'SSB' on the Selectivity control], *the sensitivity is better than 3uV for a 15dB signal to noise ratio at all frequencies throughout the range*."

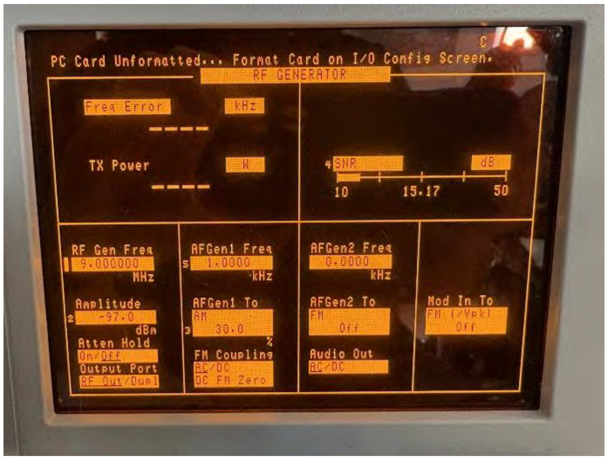


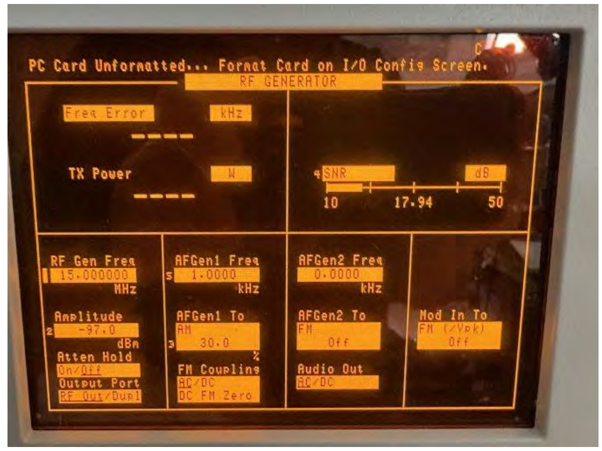
Above left: SNR on Band 9 (160KHz) = >22dB Above right: SNR on Band 8 (270KHz) = >22dB



Above left: SNR on Band 7 (450KHz) = >23dB Above right: SNR on Band 6 (2.0MHz) = >15dB

Above left: SNR on Band 5 (3.3MHz) = >13dB Above right: SNR on Band 4 (5.5MHz) = >18dB

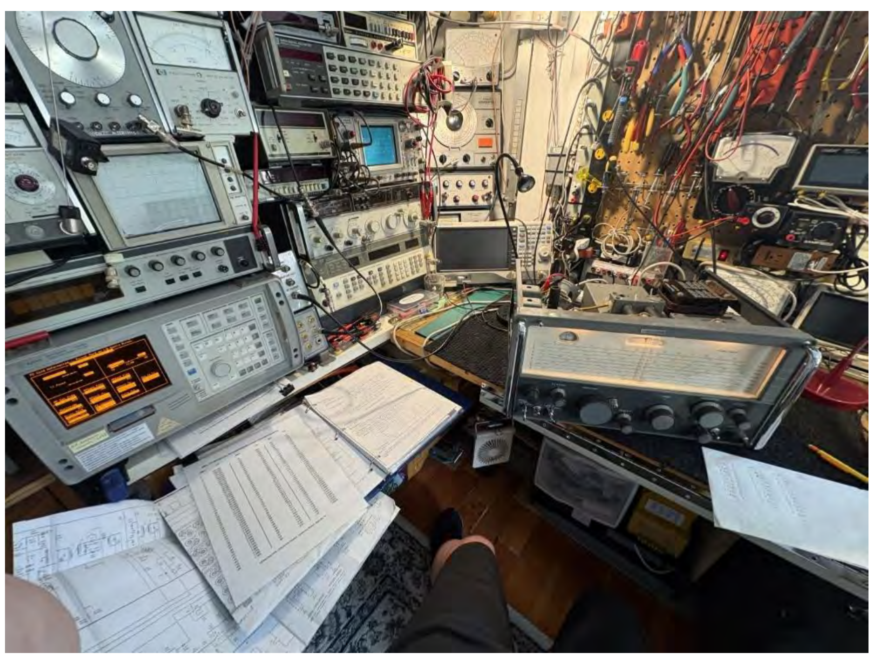




Above left: SNR on Band 3 (9.0MHz) = >15dB

Above right: SNR on Band 2 (15MHz) = >17dB

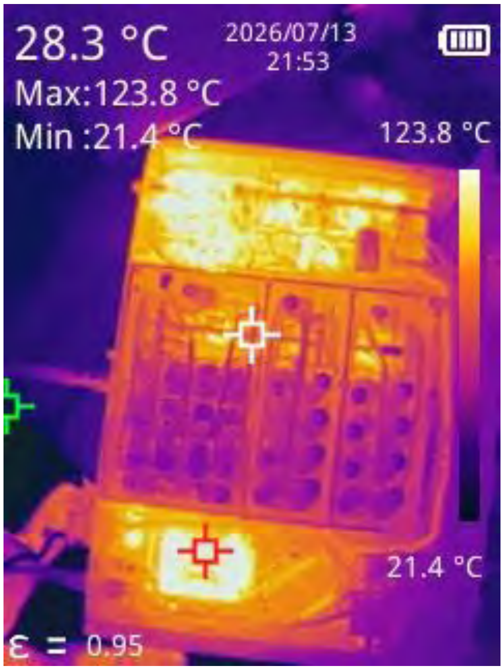
Above: SNR on Band 1 (24.0MHz) = >18dB

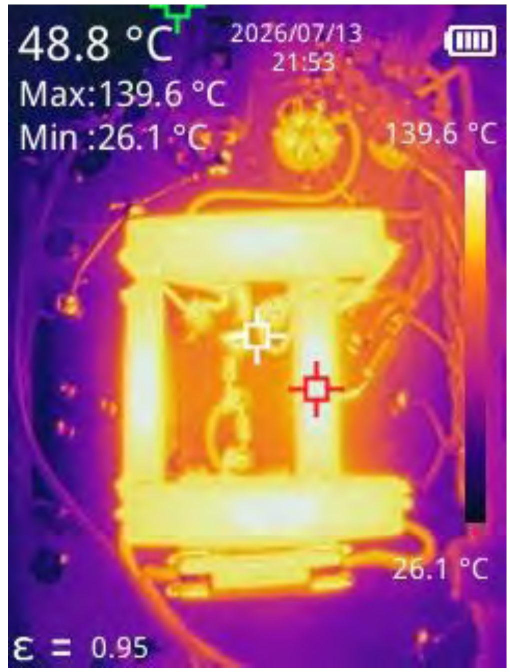


Right: Test set-up for making SNR measurements with the Agilent 8935 E6380A CDMA Test Set (located at the bottom left of the instrument stack)

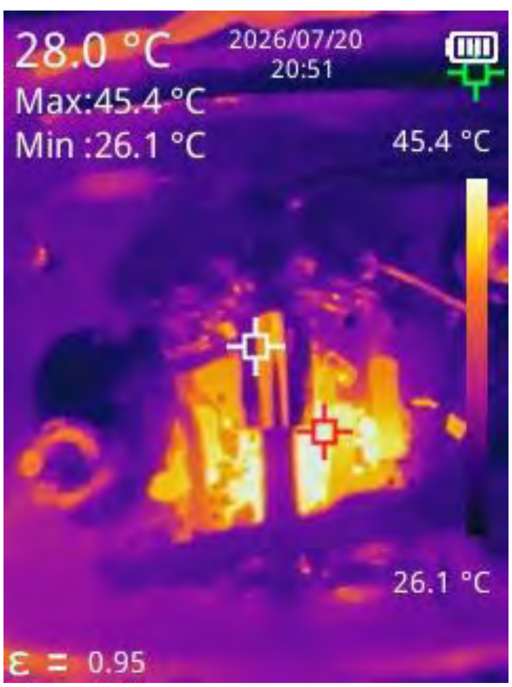
Thermal Images

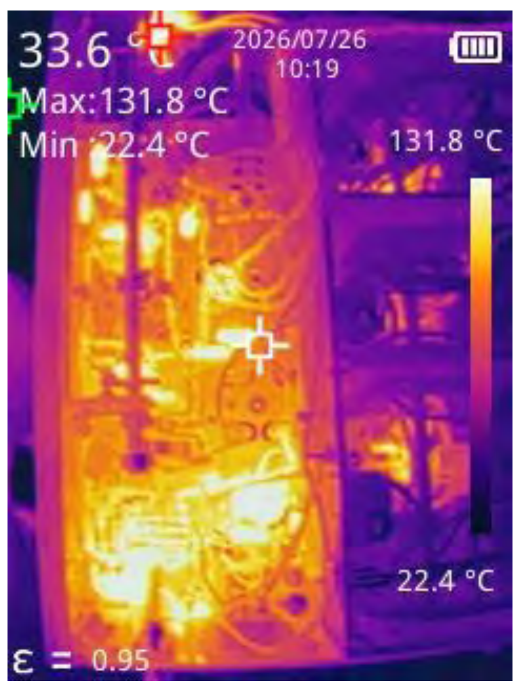
These thermal images were taken using a Topdon TC004 handheld thermal camera after approx. 2 hours operation (chassis inverted).

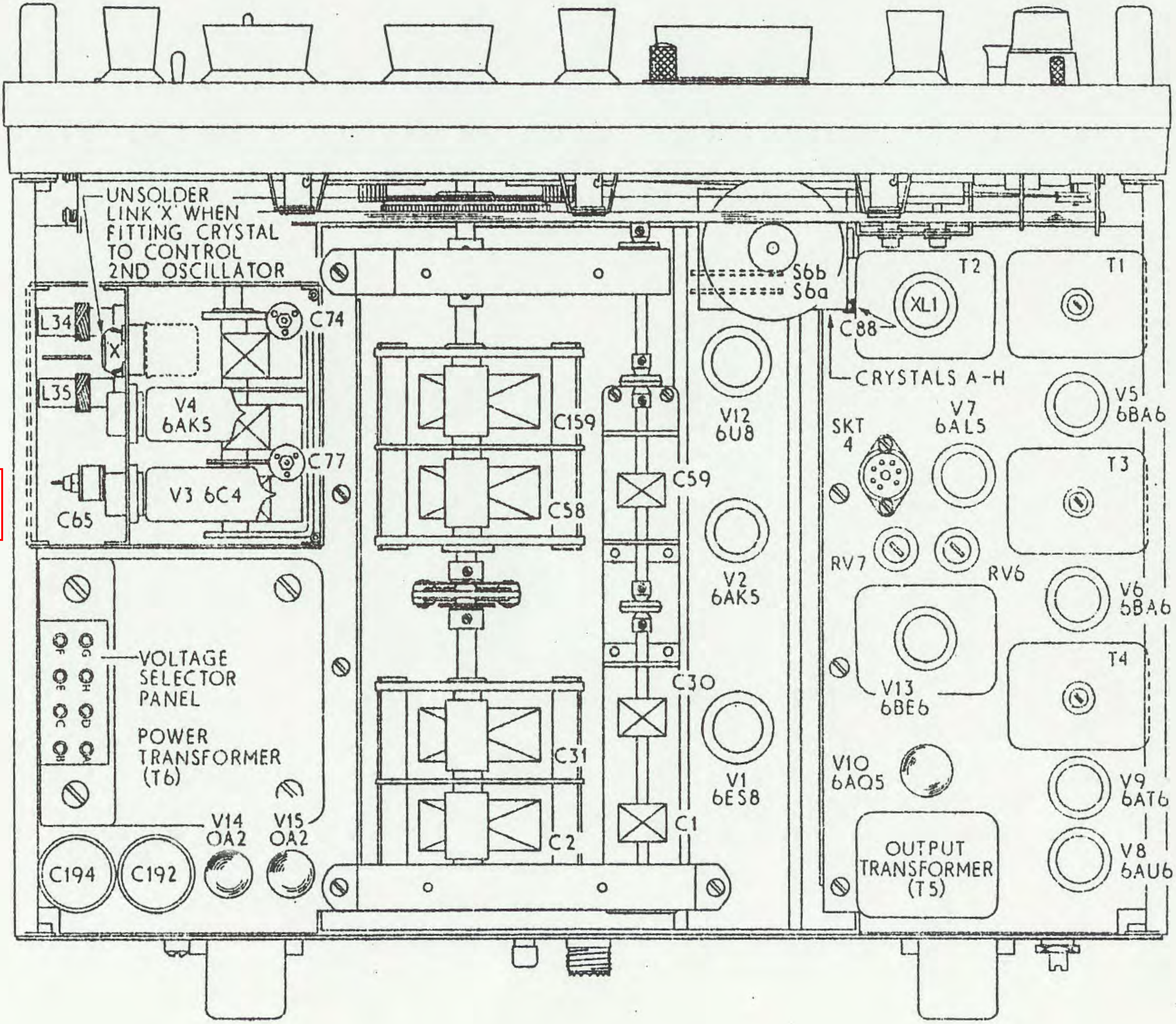




Above left: underside of the chassis. The hot spots are the four power resistors in the power supply compartment. Above right: close-up of the power resistors in the power supply compartment. The hot spot (139C) is one of the dropper resistors to one of the OA2 150v stabilizer tubes. Below left: close-up of the 1st mixer compartment. The hot spot is a 1W resistor close to the tube socket. Below right: the 2nd IF, BFO/product detector/AM detector, noise limiter, AGC and audio stages. The hot spot is one of the 2W resistors from the B+ line to the RF and IF gain controls

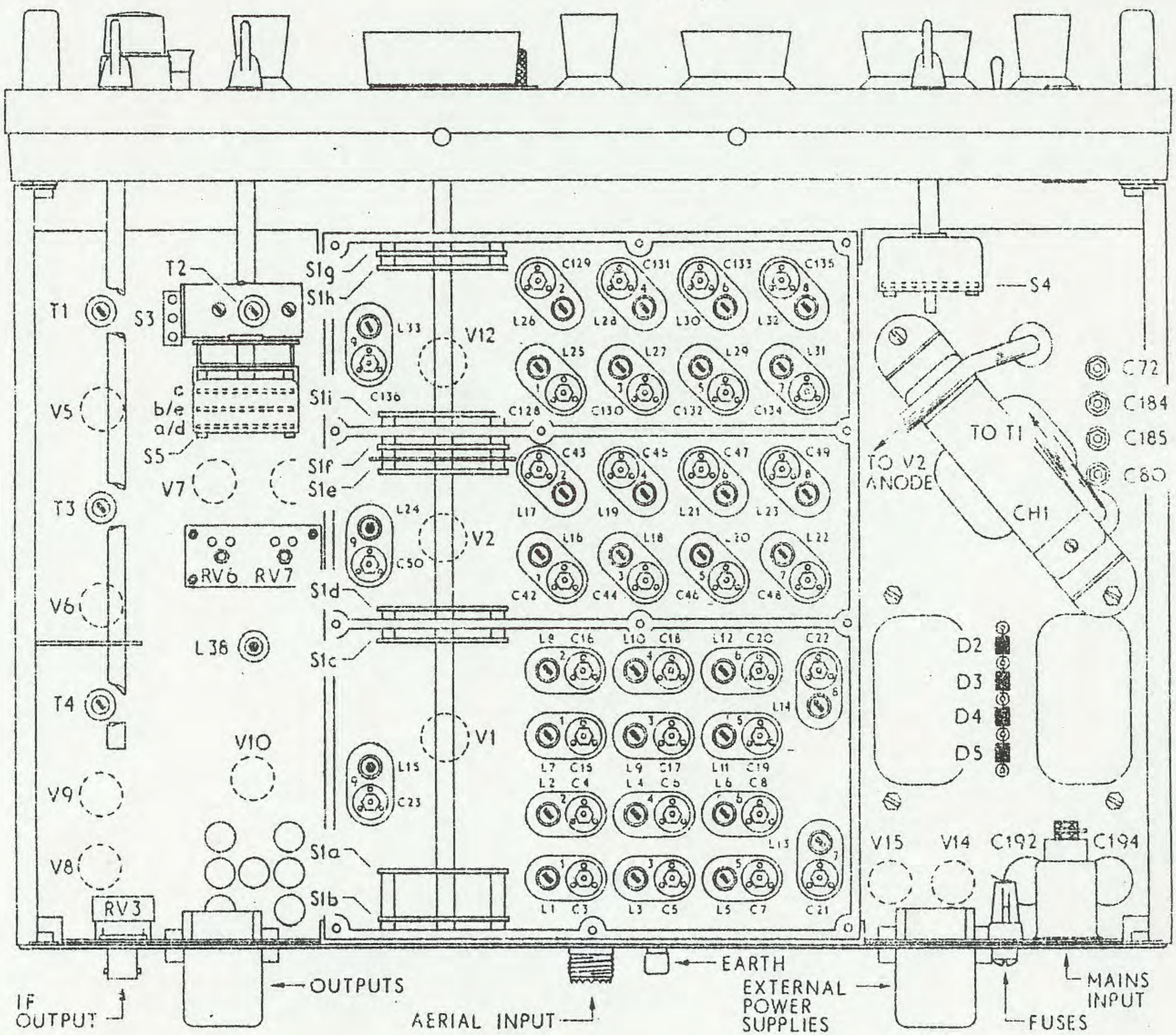


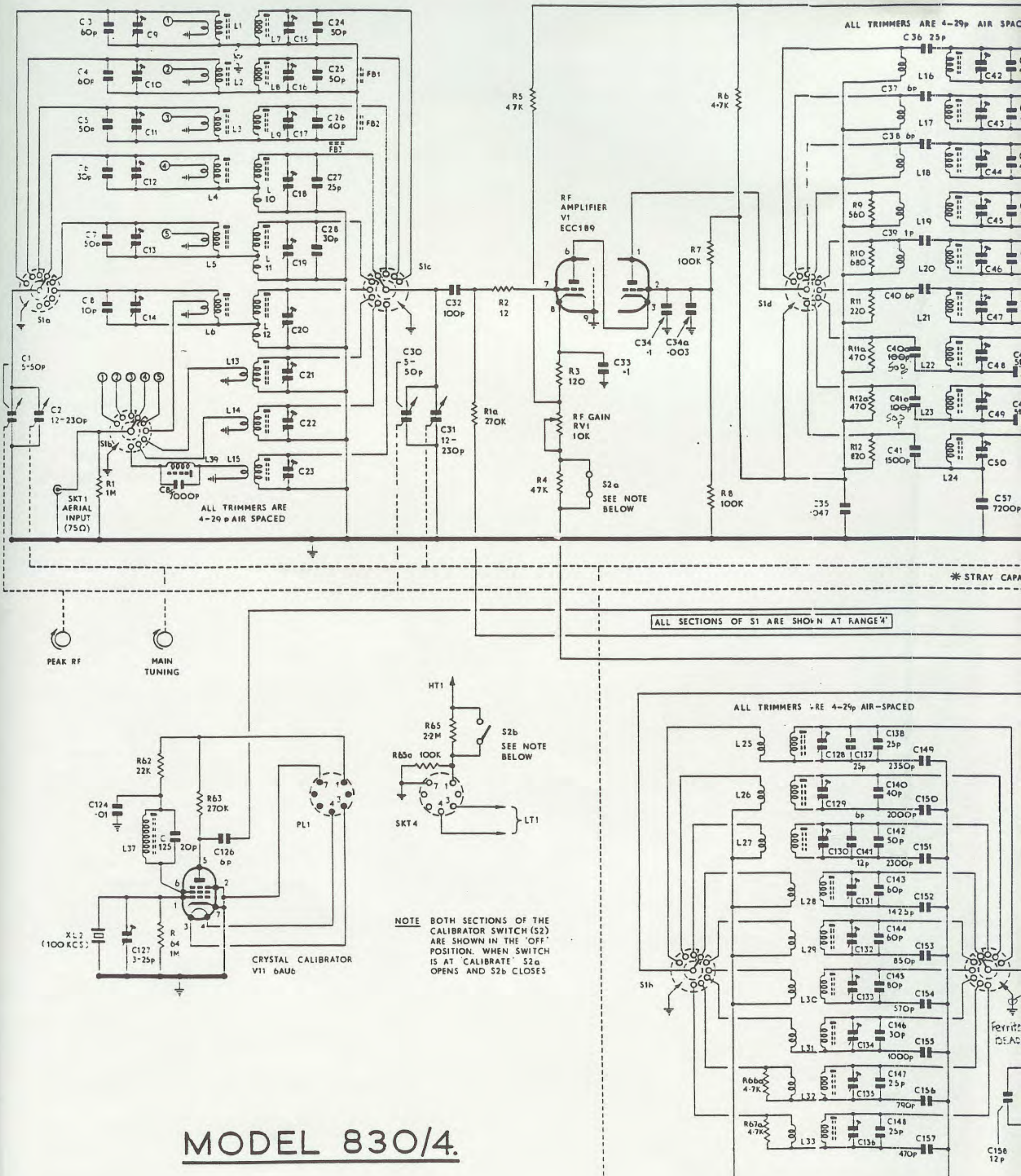




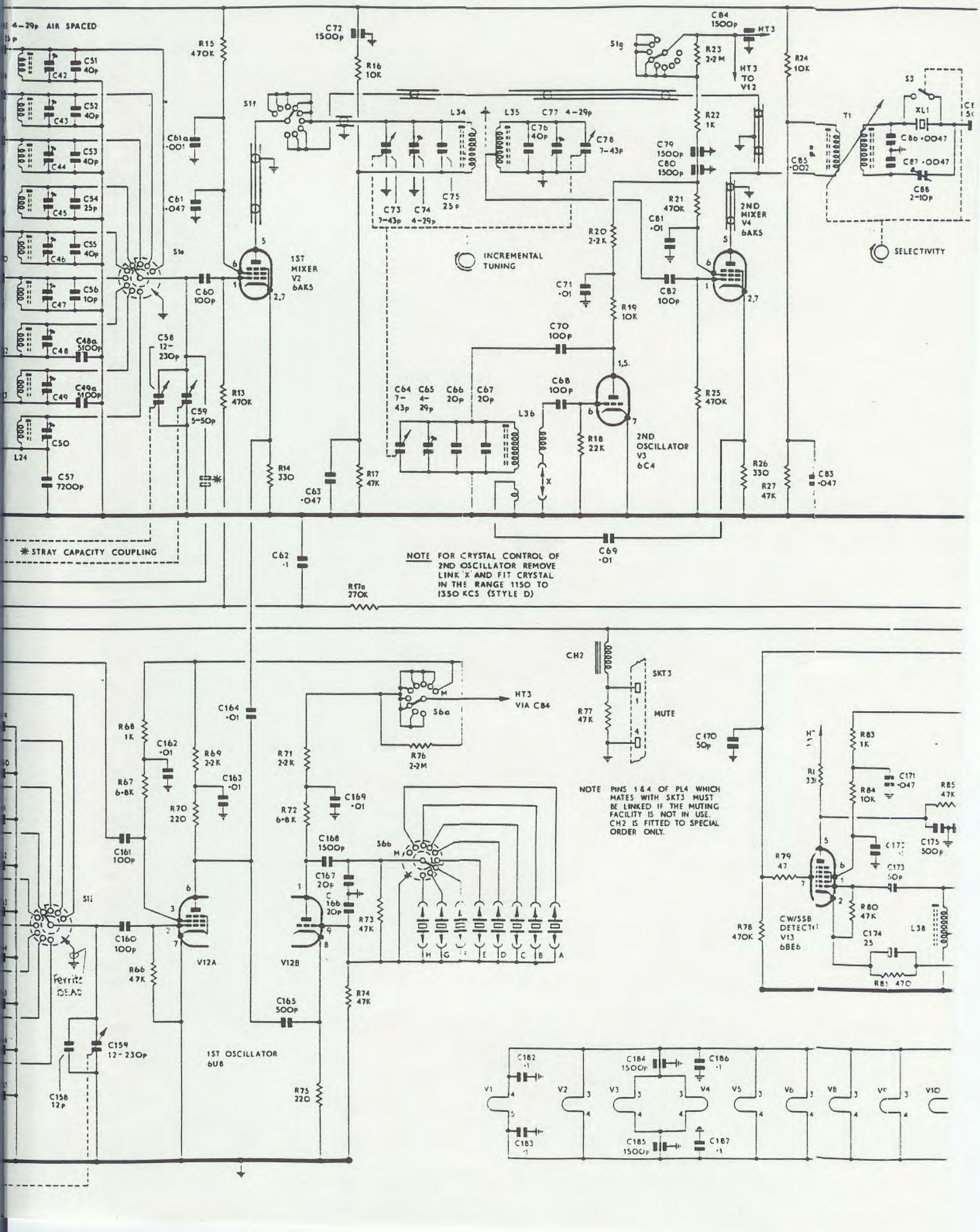
Above Chassis Layout Diagram

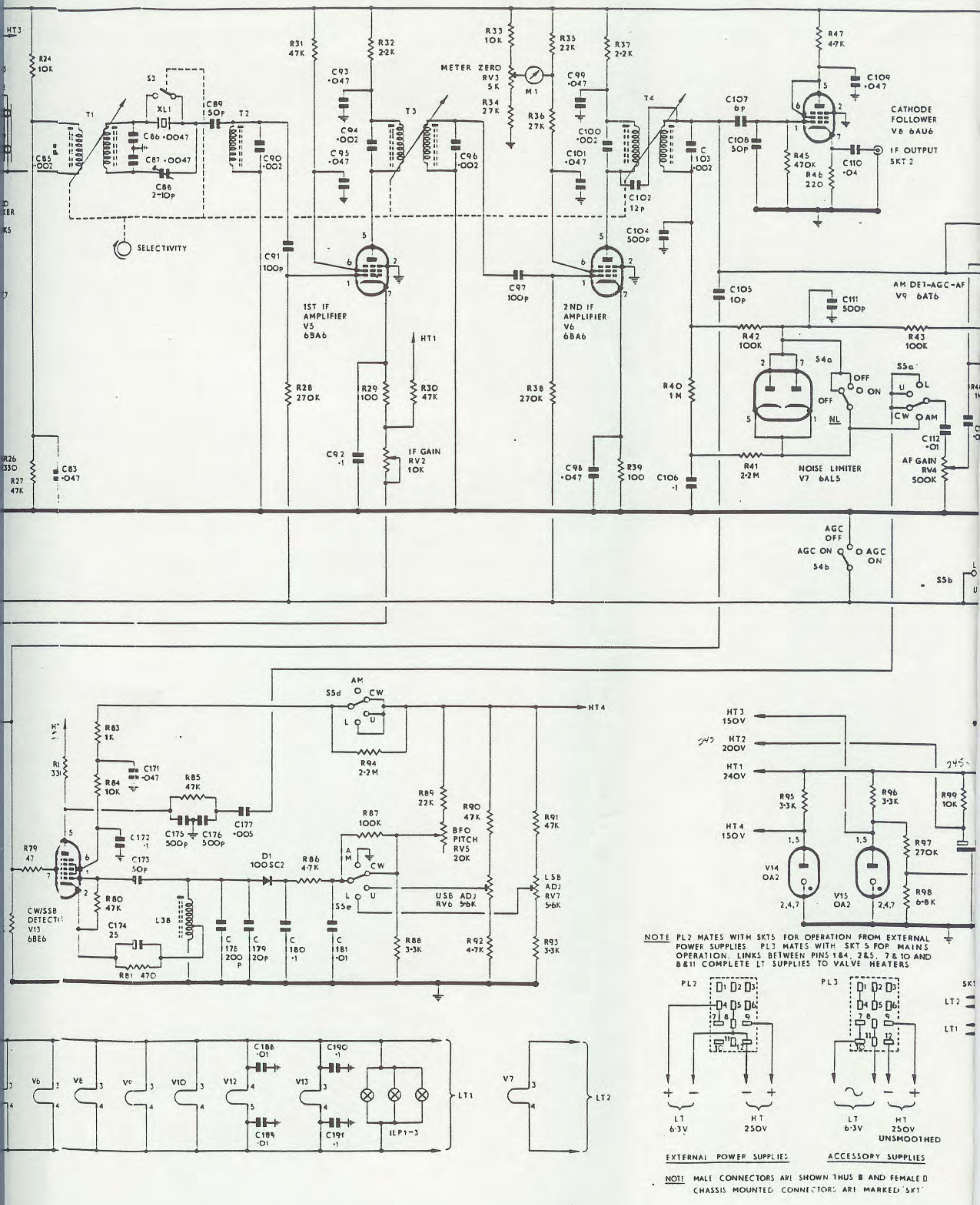
Under Chassis
Layout Diagram



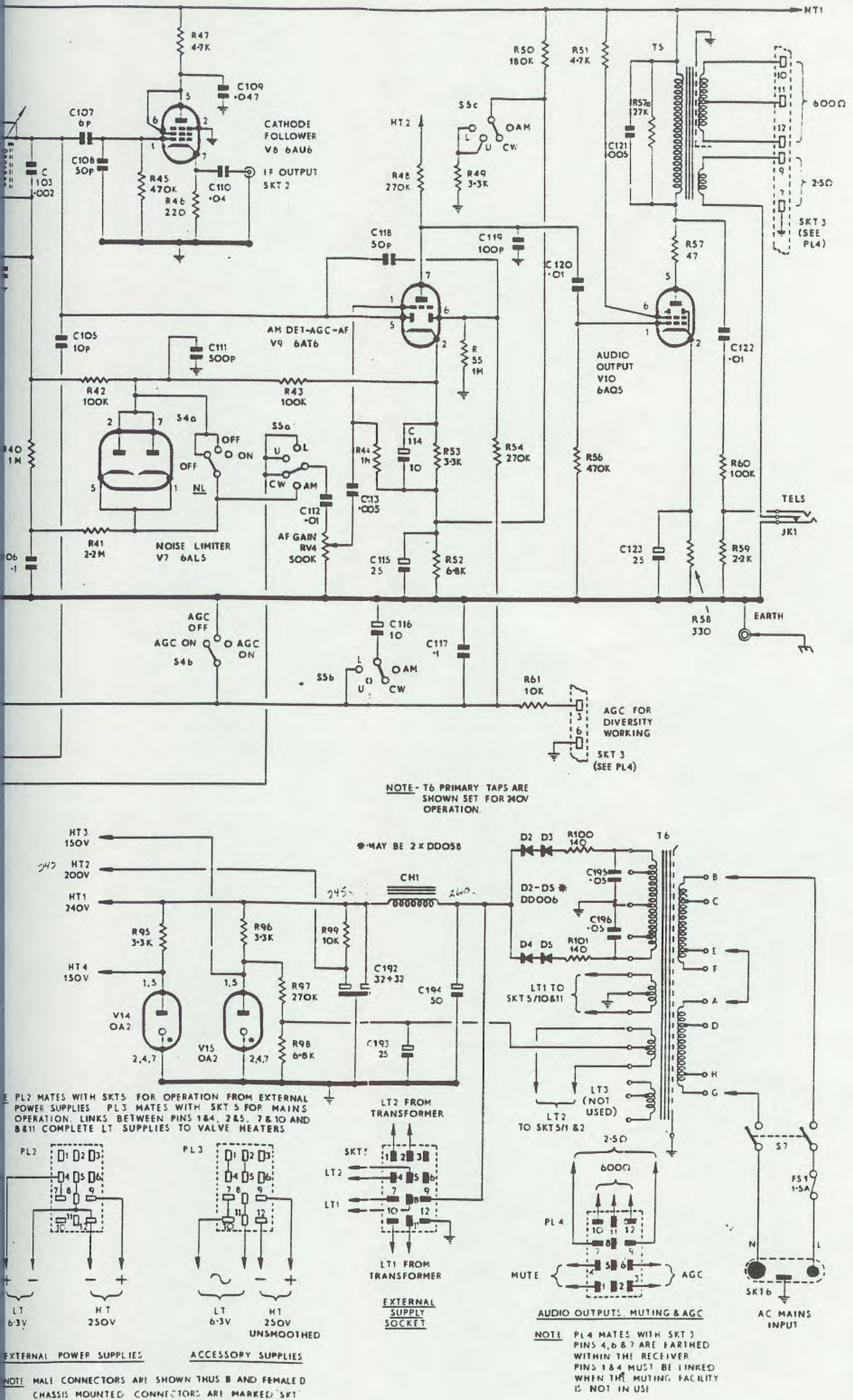

ALL TRIMMERS ARE 4-29p AIR SPAC
RF AMPLIFIER V1 ECC189
RF GAIN RV1 10K
S2a SEE NOTE BELOW
SKT1 AERIAL INPUT (75Ω)
ALL TRIMMERS ARE 4-29 p AIR SPACED
✱ STRAY CAPA
ALL SECTIONS OF S1 ARE SHOWN AT RANGE '4'
PEAK RF
MAIN TUNING
HT1
S2b SEE NOTE BELOW
SKT4
LT1
PL1
XL2 (100 KCS)
CRYSTAL CALIBRATOR V11 6AU6
NOTE BOTH SECTIONS OF THE CALIBRATOR SWITCH (S2) ARE SHOWN IN THE 'OFF' POSITION. WHEN SWITCH IS AT 'CALIBRATE' S2a OPENS AND S2b CLOSES
ALL TRIMMERS ARE 4-29p AIR-SPACED
Ferrite DEAD

MODEL 830/4.


4-29p AIR SPACED
C51 40p
C42
C52 40p
C43
C53 40p
C44
C54 25p
C45
C55 40p
C46
C56 10p
C47
C48a 5100p
C48
C49a 5100p
C49
C50
L24
C57 7200p
R15 470K
C72 1500p
R16 10K
S1f
C61a ·001
C61 ·047
S1e
C60 100p
1ST MIXER V2 6AK5
C58 12-230p
C59 5-50p
R13 470K
R14 330
C63 ·047
R17 47K
* STRAY CAPACITY COUPLING
L34
L35
C77 4-29p
C76 40p
C78 7-43p
C73 7-43p
C74 4-29p
C75 25p
INCREMENTAL TUNING
C84 1500p
HT3
S1g
R23 2·2M
HT3 TO V12
R22 1K
C79 1500p
C80 1500p
R21 470K
C81 ·01
R20 2·2K
C71 ·01
R19 10K
C82 100p
2ND MIXER V4 6AK5
C70 100p
C68 100p
C64 7-43p
C65 4-29p
C66 20p
C67 20p
L36
R18 22K
2ND OSCILLATOR V3 6C4
R25 470K
R26 330
R27 47K
C69 ·01
R24 10K
S3
T1
XL1
C86 ·0047
C87 ·0047
C85 ·002
C88 2-10p
C83 ·047
SELECTIVITY
C62 ·1
R17a 270K
NOTE FOR CRYSTAL CONTROL OF 2ND OSCILLATOR REMOVE LINK 'X' AND FIT CRYSTAL IN THE RANGE 1150 TO 1350 KCS (STYLE D)
CH2
SKT3
R77 47K
MUTE
C170 50p
NOTE PINS 1 & 4 OF PL4 WHICH MATES WITH SKT3 MUST BE LINKED IF THE MUTING FACILITY IS NOT IN USE. CH2 IS FITTED TO SPECIAL ORDER ONLY.
R68 1K
C162 ·01
R69 2·2K
C163 ·01
R67 6·8K
R70 220
C161 100p
C164 ·01
S6a
HT3 VIA C84
R76 2·2M
R71 2·2K
C169 ·01
R72 6·8K
C168 1500p
S6b
C167 20p
C166 20p
R73 47K
S1i
Ferrite BEAD
C160 100p
R66 47K
V12A
V12B
C165 500p
R74 47K
C159 12-230p
C158 12p
1ST OSCILLATOR 6U8
R75 220
R83 1K
C171 ·047
R84 10K
R85 47K
C175 500p
R79 47
C173 50p
R80 47K
CW/SSB DETECTOR V13 6BE6
R78 470K
C174 25
L38
R81 470
C182 ·1
C183 ·1
C184 1500p
C185 1500p
C186 ·1
C187 ·1
V1
V2
V3
V4
V5
V6
V8
V10



METER ZERO RV3 5K
M1
SELECTIVITY
1ST IF AMPLIFIER V5 6BA6
2ND IF AMPLIFIER V6 6BA6
CATHODE FOLLOWER V8 6AU6
IF OUTPUT SKT 2
AM DET-AGC-AF V9 6AT6
IF GAIN RV2 10K
NOISE LIMITER V7 6AL5
AF GAIN RV4 500K
AGC OFF
AGC ON
AGC ON
S4b
S5b
CW/SSB DETECTOR V13 6BE6
BFO PITCH RV5 20K
USB ADJ RV6 5·6K
LSB ADJ RV7 5·6K
HT4
HT3 150V
HT2 200V
HT1 240V
HT4 150V
V14 OA2
V15 OA2
LT1
LT2
ILP1-3
NOTE PL2 MATES WITH SKT5 FOR OPERATION FROM EXTERNAL POWER SUPPLIES. PL3 MATES WITH SKT 5 FOR MAINS OPERATION. LINKS BETWEEN PINS 1&4, 2&5, 7&10 AND 8&11 COMPLETE LT SUPPLIES TO VALVE HEATERS
PL2
PL3
LT 6·3V
HT 250V
LT 6·3V
HT 250V UNSMOOTHED
EXTERNAL POWER SUPPLIES
ACCESSORY SUPPLIES
NOTE MALE CONNECTORS ARE SHOWN THUS ▮ AND FEMALE ▯ CHASSIS MOUNTED CONNECTORS ARE MARKED 'SKT'


HT1
R47 4·7K
C109 ·047
C107 6P
C108 50p
C 103 ·002
R45 470K
R46 220
C110 ·04
CATHODE FOLLOWER V8 6AU6
IF OUTPUT SKT 2
R50 180K
R51 4·7K
T5
S5c
HT 2
L U CW OAM
R48 270K
R49 3·3K
R57a 27K
C121 ·005
600Ω
2·5Ω
SKT 3 (SEE PL4)
C118 50p
C119 100P
C 120 ·01
R57 47
C105 10p
C111 500P
AM DET-AGC-AF V9 6AT6
R 55 1M
AUDIO OUTPUT V10 6AQ5
C122 ·01
R42 100K
R43 100K
S4a OFF ON
S5a L U CW OAM
NL
R40 1M
R44 1M
C 114 10
R53 3·3K
R54 270K
R56 470K
R60 100K
TELS JK1
C112 ·01
C113 ·005
R41 2·2M
NOISE LIMITER V7 6AL5
AF GAIN RV4 500K
C115 25
R52 6·8K
C123 25
R59 2·2K
R58 330
EARTH
AGC OFF
AGC ON
AGC ON
S4b
C116 10
C117 ·1
S5b
L U OAM CW
R61 10K
AGC FOR DIVERSITY WORKING
SKT 3 (SEE PL4)
NOTE - T6 PRIMARY TAPS ARE SHOWN SET FOR 240V OPERATION.
HT3 150V
HT2 200V
HT1 240V
HT4 150V
*MAY BE 2 x DD058
CH1
D2 D3
R100 140
T6
C195 ·05
D2-D5 * DD006
C196 ·05
D4 D5
R101 140
R95 3·3K
R96 3·3K
R99 10K
C192 32+32
R97 270K
C194 50
LT1 TO SKT 5/10&11
V14 OA2
V15 OA2
R98 6·8K
C193 25
LT3 (NOT USED)
LT2 TO SKT5/1 &2
PL2 MATES WITH SKT5 FOR OPERATION FROM EXTERNAL POWER SUPPLIES. PL3 MATES WITH SKT 5 FOR MAINS OPERATION. LINKS BETWEEN PINS 1&4, 2&5, 7 & 10 AND 8&11 COMPLETE LT SUPPLIES TO VALVE HEATERS
PL2
PL3
LT2 FROM TRANSFORMER
SKT5
LT2
LT1
LT1 FROM TRANSFORMER
EXTERNAL SUPPLY SOCKET
2·5Ω
600Ω
PL 4
MUTE
AGC
S7
FS1 1·5A
N L
SKT6
AC MAINS INPUT
LT 6·3V
HT 250V
LT 6·3V
HT 250V UNSMOOTHED
EXTERNAL POWER SUPPLIES
ACCESSORY SUPPLIES
AUDIO OUTPUTS, MUTING & AGC
NOTE PL4 MATES WITH SKT 3 PINS 4, 6 & 7 ARE EARTHED WITHIN THE RECEIVER PINS 1 & 4 MUST BE LINKED WHEN THE MUTING FACILITY IS NOT IN USE
NOTE MALE CONNECTORS ARE SHOWN THUS ▮ AND FEMALE ▯ CHASSIS MOUNTED CONNECTORS ARE MARKED 'SKT'